Vol. XXXV MARCH, 1952 No. 10

THE PHILIPPINE AGRICULTURIST

UNIVERSITY OF THE PHILIPPINES PUBLICATIONS SERIES A

CONTENTS

The Curvularia Disease of Gladiolus in the Philippines	*Victoria Mendiola-Ela*	517
The Influence of Varying Amounts of Fertilizers and Levels of Moisture Saturation on Yield of Elon-elon and Inintiw Strain 107	*Leonardo A. Abarra*	539
Influence of the Rate of Seeding on Yield of Fiber and Seed and on Quality of Fiber of Kenaf	*Tobias B. Manzano*	561
The Growth and Habits of Lambs	*Rufino M. Sojetado*	572
Two Standard Rations for Growing and Fattening Pigs	*Teodoro de Juaregui*	579
The Shrinkage of Concentrates in Storage	*Valente Villegas*	584
College and Alumni Notes		587

Published by

THE COLLEGE OF AGRICULTURE
AND CENTRAL EXPERIMENT STATION
UNIVERSITY OF THE PHILIPPINES

COMMONWEALTH MYCOLOGICAL INSTITUTE
8 OCT 1953

The Philippine Agriculturist

(University of the Philippines Publications Series A)

Editor

L. B. UICHANCO, SC.D. ..... *Dean, College of Agriculture*

Managing Editor

G. O. OCFEMIA, PH.D. ..... *Professor of Plant Pathology*

Copy Editor

NORA J. CRUZ, A.B. ..... *Instructor in English*

Business Manager

JOSÉ M. CAPINPIN, PH.D. ..... *Associate Professor of Agricultural Botany*

Advisory Board

F. O. SANTOS, PH.D. ..... *Head, Department of Agricultural Chemistry*
VALENTE VILLEGAS, PH.D. ..... *Head, Department of Animal Husbandry*
FRANCISCO M. SACAY, PH.D. ..... *Head, Department of Agricultural Education*
LEON G. GONZALEZ, PH.D. ..... *Head, Department of Agronomy*
A. B. CATAMBAY, M.S. ..... *Head, Department of Agricultural Engineering*
SILVERIO M. CENDAÑA, PH.D. ..... *Assistant Head, Department of Entomology*
NICOLAS L. GALVEZ, PH.D. ..... *Acting Head, Department of Soils*

Authors of articles appearing in THE PHILIPPINE AGRICULTURIST are severally responsible for the opinions expressed therein.

THE PHILIPPINE AGRICULTURIST is published monthly, except in April and May, beginning with Volume 35, by the College of Agriculture and Central Experiment Station, University of the Philippines, Los Baños, Laguna. The subscription price is ₱6.00 a year in the Philippines and $4.00 (U.S. currency) elsewhere; the price of single copies, ₱0.75 in the Philippines and $0.50 (U.S. currency) elsewhere.

Business correspondence should be addressed to the Business Manager, THE PHILIPPINE AGRICULTURIST, College, Laguna, Philippines. All remittances should be made payable to THE PHILIPPINE AGRICULTURIST.

Communications for the editor should be addressed to the Editor, THE PHILIPPINE AGRICULTURIST, College, Laguna, Philippines.

Publications sent in exchange for THE PHILIPPINE AGRICULTURIST should be addressed: Library, College of Agriculture and Central Experiment Station, College, Laguna, Philippines.

Entered at the Post Office at College, Laguna, Philippines, as second-class mail matter.

THE CURVULARIA DISEASE OF GLADIOLUS IN THE PHILIPPINES [1]

VICTORIA MENDIOLA-ELA [2]

WITH TWO PLATES AND THREE TEXT FIGURES

Gladiolus, or sword lily (*Gladiolus segetum* Ker.), is an ornamental plant very well-adapted to gardening or landscaping and to the cut-flower industry. Its flowers of different colors, characters, and sizes are suitable for use in tall vases and baskets for all occasions. It can be grown profitably in the Philippines. It flowers at any time of the year, though usually the corms are planted in the early part of August and the flowers are available for the flower shops by November and December, when the demand is greatest and the price highest.

As a cut flower, gladiolus is second only to such orchids as waling-waling, *Vanda sanderiana* Reichb., and *Cattleya* in beauty and market value. Gladiolus ranks first among the other important commercial flowers, like the roses (*Rosa* spp.) ; mariposa orchid (*Phalaenopsis aphrodite* Ames) and dapo tigre (*Phalaenopsis schilleriana* Reichb.) ; azucena, or tuberose (*Polianthes tuberosa* Linn.) ; gerbera, Transvaal, or African daisy (*Gerbera jamesoni*) ; Calla lily (*Richardia africana*), Benguet lily (*Lilium philippinensis* Baker), and Amazon lily (*Eucharis grandiflora* Planch and Linden) ; dahlia (*Dahlia variabilis* Desf.) ; and zinnia (*Zinnia multiflora* Linn.). It is a profitable flower for the grower and the flower-shop owner; hence, its major disease deserves consideration.

THE DISEASE

The *Curvularia* spot is a hitherto unreported disease of gladiolus in the Philippines. Its occurrence on two popular commercial varieties, Picardy and Margaret Beaton, in a garden in the vicinity of the College of Agriculture at Los Baños, Laguna, first attracted attention on September 15, 1950, two years after Magie (1948) reported a similar disease in Florida and Alabama in the United States. After two years of continuous planting of gladiolus in the same field, the disease became very serious and caused 90 per cent infection, or 70 per cent more than the first year. The disease was also noted on these two varieties in isolated gladiolus-producing fields.

---

[1] Central Experiment Station Contribution No. 1652.

[2] The writer thanks Dr. G. O. Ocfemia for reading the manuscript, Dr. Faustino T. Orillo for assistance in the determination of the fungus, and Mr. Mario O. San Juan for assistance in the preparation of the drawings.

The writer also thanks Messrs. Moises Villaluz, Pedro Peralta, and Ponciano Ortis, gladiolus growers, for furnishing materials infected with the disease.

[THE PHILIPPINE AGRICULTURIST, Vol. 35, No. 9, February, 1952, appeared in May, 1953]

Microscopic examinations of diseased specimens consistently revealed conidiophores and conidia of *Curvularia,* a genus established by Boedijn in 1933. A species, *Curvularia lunata* (Wakker) Boedijn (*Acrothecium lunatum* Wakker), was first found on sugar cane in Java in 1898 and as one of the isolates from the air and from several plants, including castor bean and mango (Boedijn, 1933). This species is one of the common saprophytes associated with decaying banana tissues and old banana leaf spots and fruit spots (Wardlaw, 1935). It is also commonly found in the soil (Gilman, 1945). Tullis (1936) found it as the most common fungus on discolored rice kernels in southern United States. Taubenhaus (1935) and Martin [3] suspected it to be the possible cause of black kernels in rice, with rice straw as the source of infection, and Padwick (1948) showed it to be one of the causes of leaf spot of rice in India. Magie (1948) proved it to be the cause of spotting of gladiolus in Florida and Alabama. A similar, if not identical, disease was found by Plakidas [4] in Mississippi, and a *Curvularia* disease of gladiolus was reported by Limber [5] in Louisiana, Maryland, North Carolina, New York, and Michigan. During the war, *Curvularia lunata* was isolated very frequently from deteriorated industrial and military equipment from the tropics.

The disease of gladiolus in the Philippines referred to in this paper resembles Magie's *Curvularia* disease described in 1948. It affects the entire plant, causing severe spotting in the field. The spots become black in warm and moist weather. The disease is severe up to the flowering stage; the spots on the spikes and flowers continue to develop even after the flowers are cut and are in transit, rendering the flowers unmarketable. The disease almost wiped out the writer's small gladiolus planting of about 1000 plants. If nothing is done to check the disease, it will seriously affect the young but profitable gladiolus industry in the Philippines.

As nothing is known of the disease in the Philippines and only fragmentary information from elsewhere is available, this work was undertaken to assist local gladiolus growers.

Symptoms

The disease causes severe spotting of the leaves and flowers. It also affects the stems, spikes, stipules, and even the corms.

On the leaves. The leaves of plants that arise from corms and cormlets show spots of varying sizes which are visible on both sur-

---

[3] MARTIN, ALAN L. 1939a. Possible cause of black kernels in rice. Plant Disease Reporter **23**: 83–84.

MARTIN, ALAN L. 1939b. Rice straw stacks as a source of infection with the black kernel disease. Plant Disease Reporter **23**: 247–249.

[4] PLAKIDAS, A. G. 1948. *Curvularia* spot of gladioli from Mississippi. Plant Disease Reporter **32**: 449.

[5] LIMBER, DONALD P. 1949. Notes on *Curvularia* sp. on gladiolus, with five new distribution records. Plant Disease Reporter **33**: 66–68.

faces. The spots may be numerous or few, small, and more or less circular. The smallest spot measures approximately 1 mm. or less in diameter, and the large and elongate ones are approximately 70 mm. long by 30 mm. wide (Pl. I, fig. 1). In the early stage of the disease, the spots appear as pale yellow areas. With age, they either remain small or they enlarge and their central areas become sunken and are colored brown or tan (orange cinnamon).[6] Each spot is surrounded by a reddish-brown or purplish-brown (Mikado brown) ring. The whole area is further surrounded by a light yellow area. In severe cases of infection, two or more spots coalesce or the larger spots enlarge further to form blotches. Several of these blotches may occur especially on the upper part of the leaf. After continuous rains and when the weather is warm and moist, the central orange-cinamon areas become brown (mouse gray) and then black (deep mouse gray) because of the production of conidiophores and conidia by the causal fungus. In very severe cases, the central portions of the big blotches fall off after the death of the cells.

On the stems, spikes, and stipules. Small, more or less elongate, sunken, light brown spots, 6 mm. or less in length and 2 mm. in width, appear on the stems, spikes, and stipules. These spots enlarge and become more elongate, dark brown, sunken, and 60 mm. long and 10 mm. wide (Pl. I, figs. 1 and 2). Like the spots on the leaves, those on the stems, spikes, and stipules also turn black because of production of conidiophores and conidia by the causal fungus.

On the flowers. The spots appear first as small, colorless, and watersoaked areas on any portion of the opened and unopened flowers. These spots enlarge to form blotches which are irregularly circular or elongate and are light yellow, then brown (orange cinnamon), and finally black, also because of the production of conidiophores and conidia (Pl. I, figs. 1 and 2). The spots on the spikes, stipules, and flowers continue to develop on the cut flowers in transit, rendering the spikes unfit for the flower market.

On the corms. Diseased corms bear irregularly circular, sunken, brown spots. These corms when planted produce plants with much larger spots on the leaves.

CAUSAL ORGANISM

The fungus was easily isolated from the diseased tissues of the flowers, stems, leaves, and corms by both the tissue-culture and single-spore methods. Small sections from young lesions were cut, disinfected one by one with 1:1000 mercuric chloride solution for 20 to 30 seconds, washed in three changes of sterile distilled water, and plated out in sterilized Petri dishes containing hardened potato-dex-

[6] The color nomenclatures followed in these studies are those of Robert Ridgway.

trose agar. Transfers were made from the edge of the growth that developed on the agar in the plates after two days into test tubes of slant agar. The organism was also isolated by placing some spores of the fungus in test tubes of dissolved potato-dextrose agar which had been cooled to about 40°C. Each tube containing the agar with the spores suspended in it was rolled between the hands to distribute the spores uniformly. Then the suspension was poured into sterile Petri dishes, and the dishes were rotated gently with slight tipping to distribute the spores in the agar before it congealed. The spores were allowed to germinate and on the next day, isolated germinating spores were picked up with a flattened platinum needle and transferred to another plate of potato-dextrose agar. Then transfers of the resultant growth to test tubes of slant agar were made.

The cultures obtained by the first method compared favorably with those obtained by the second method.

The isolations were made on September 15 and 20 and in the latter part of October, 1950. The subcultures from these were used in the study of the morphology, physiology, and pathogenicity of the fungus.

Morphology

Mycelium. In pure culture on various agar media and sterilized plant tissues, the fungus produces dense growth of mycelium. Under the microscope, the aerial mycelium is smooth, septate, and branched (Pl. II, fig. 1). When a day or two old it is hyaline to light olivaceous, but it becomes pale brown (light olive gray), then blackish-brown (dark olive gray), with age. Measurements of 200 hyphal cells show that the length ranges from 7.0 to 59.5 microns, with an average of 21.8 microns, and the diameter, from 1.0 to 7.0 microns, with an average of 3.87 microns. On agar media the fungus produces submerged mycelium which is also septate and branched, but at times after seven days, it begins to produce short cells which become globular or elliptical and thick-walled (Pl. II, figs. 1 and 7), with diameters from 7.6 to 19.25 microns, or an average of 13.3 microns. These thick-walled hyphal cells are darker in color, are more granular than the ordinary cells, and are produced in chains or in bunches (Pl. II, fig. 7). The masses of these thick-walled cells appear as numerous minute black stroma-like bodies on agar cultures. The function of these cells could not be ascertained, although the writer believes that they help the fungus in surmounting adverse conditions in the corms, in the debris, and in the soil.

Conidiophores. The conidiophores on the diseased tissues are aerial, pale brown near the apex and dark brown at the basal portion, unbranched, septate, somewhat swollen at the base; they occur in most cases in groups of two or as many as nine (Pl. II, fig. 2). In culture on agar media they arise singly, more or less at right angles from the main hyphae (Pl. II, fig. 4). On agar in Van

Tieghem cells and on smears on sterile slides kept in a moist chamber, they are formed after 24 hours on the sides and tips of hyphae. They differ from ordinary hyphae in that they are olivaceous, or brownish, in color. They bear scars marking the points of attachment of the spores at intervals of 3.5 to 17.5 microns, or an average of 6.875 microns, and have slight geniculations near the tip. When the weather is warm and moist, the spots on leaves, spikes, and flowers produce luxuriant growths of conidiophores and conidia which cause the spots to appear black. Measurements of 200 conidiophores show that the length varies from 38.5 to 210 microns, or an average of 90.95 microns, and the diameter, from 3.5 to 7.0 microns, or an average of 4.3 microns.

Conidia. The conidia are produced abundantly on diseased host tissues and on most of the culture media used. They are typically curved and 3-septate. One of the central cells, the third from the base, is distinctly larger and darker than the terminal cells. Each spore has a hilum protruding from the basal end (Pl. II, figs. 3 and 5). Conidium formation was studied on dilute potato-dextrose agar in Van Tieghem cells and on some agar smears on sterile slides kept in a moist chamber, in a way similar to that described by Ocfemia (1924). The spores were found to be borne terminally and laterally on the geniculations. They are hyaline, non-septate, and almost straight when young and are pale brown (light olive gray) to blackish-brown (dark olive gray), septate, and uneven-celled when fully formed.

Measurements of the length and width of 200 conidia from the diseased host tissues and 200 from the 5- to 7-day-old pure cultures on potato-dextrose agar are given in table A. The values are distributed into classes made by a difference of two microns.

TABLE A

Distribution of the lengths and widths of conidia of the Philippine Curvularia on gladiolus in classes made by a difference of two microns

LENGTH CLASSES IN MICRONS	CONIDIA FROM		WIDTH CLASSES IN MICRONS	CONIDIA FROM	
	Host	Culture		Host	Culture
—	—	—	6.5– 8.49	—	6
—	—	—	8.5–10.49	17	66
—	—	—	10.5–12.49	159	125
—	—	—	12.5–14.49	21	3
—	—	—	14.5–16.49	3	—
16.5–18.49	—	1	—	—	—
18.5–20.49	2	2	—	—	—
20.5–22.49	19	9	—	—	—
22.5–24.49	4	9	—	—	—
24.5–26.49	59	51	—	—	—
26.5–28.49	60	59	—	—	—
28.5–30.49	12	20	—	—	—
30.5–32.49	34	35	—	—	—
32.5–34.49	7	9	—	—	—
34.5–36.49	3	5	—	—	—

It may be noted that the lengths of 200 conidia from the diseased host tissues fall under classes between 18.5 to 20.49 microns and 34.5 to 36.49 microns. The majority have lengths in classes between 24.5 to 26.49 microns. The widths fall under classes between 8.5 to 10.49 microns and 14.5 to 16.49 microns, and the majority have widths in classes between 10.5 to 12.49 microns.

Of the 200 conidia from the 5- to 7-day-old cultures on potato-dextrose agar, the lengths fall under classes between 16.5 to 18.49

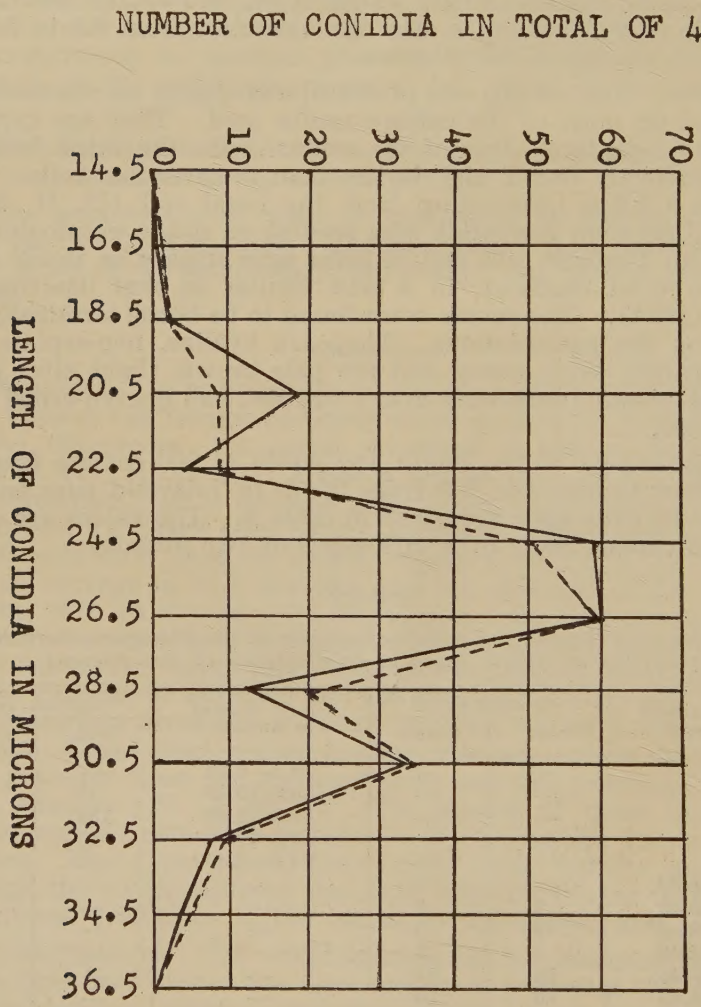


Fig. 1.—The variation in length of conidia of the Philippine *Curvularia* taken from the host and from the culture.
— = variation in length of the conidia from the host
.... = variation in length of the conidia from the culture

microns and 34.5 to 36.49 microns. The majority have lengths in classes between 24.5 to 26.49 microns and 26.5 to 28.49 microns. The widths fall under classes between 6.5 to 8.49 microns and 12.5 to 14.49 microns, and the majority have widths in classes between 10.5 to 12.49 microns. In both field materials and pure cultures, most of the conidia have lengths in classes 26.5 to 28.49 microns and widths in classes 10.5 to 12.49 microns. The average size of the 200 conidia from the host is 27.3 × 11.4 microns, and that of the 200 spores from pure cultures, 27.7 × 10.1 microns. Figures 1 and 2 are graphic representations of the measurements of the conidia.

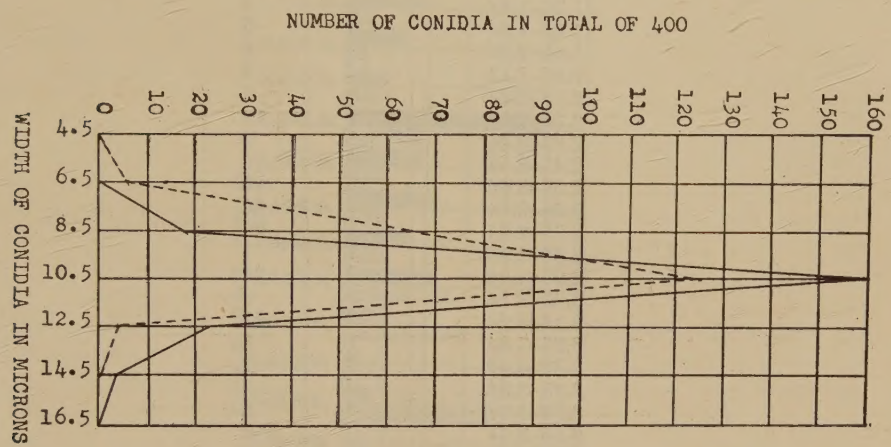


Fig. 2.—The variation in width of conidia of the Philippine *Curvularia* taken from the host and from the culture.
— = variation in width of the conidia from the host
.... = variation in width of the conidia from the culture

Ratios of length of conidia to width. The ratios of length to width of 200 conidia from the host and 200 from pure culture were determined and distributed into classes made by a difference of 0.09 microns as shown in table B.

It may be seen that 51 have a ratio of 2.25 to 2.34; 22 have a ratio of 2.65 to 2.74; 21 have a ratio of 2.45 to 2.54; 19 have a ratio of 1.95 to 2.04; 18 have a ratio of 2.35 to 2.44; 15 have a ratio of 2.55 to 2.64; and 14 have a ratio of 2.05 to 2.14. The average ratio of length to width of 200 conidia from the host is 2.379.

Of 200 conidia from pure cultures, 36 have a ratio of 2.95 to 3.04; 29 have a ratio of 2.75 to 2.84; 26 have a ratio of 2.65 to 2.74; 21 have a ratio of 3.15 to 3.24; 18 have a ratio of 2.25 to 2.34; 10 have a ratio of 2.45 to 2.54; and 10 have a ratio of 2.55 to 2.64. The average ratio of length to width of the 400 conidia from both sources is 2.578.

TABLE B

Ratios of length to width of 400 conidia of the Philippine Curvularia distributed in classes made by a difference of 0.09 micron

RATIO CLASSES IN MICRONS	NUMBER OF CONIDIA	
	200 from host	200 from culture
1.45–1.54	1	0
1.55–1.64	0	0
1.65–1.74	3	0
1.75–1.84	2	0
1.85–1.94	4	0
1.95–2.04	19	6
2.05–2.14	14	3
2.15–2.24	9	7
2.25–2.34	51	18
2.35–2.44	18	9
2.45–2.54	21	10
2.55–8.64	15	10
2.65–2.74	22	26
2.75–2.84	7	29
2.85–2.94	7	7
2.95–3.04	3	36
3.05–3.14	0	6
3.15–3.24	3	21
3.25–3.34	1	6
3.35–3.44	0	2
3.45–3.54	0	0
3.55–3.64	0	2
3.65–3.74	0	0
3.75–3.84	0	0
3.85–3.94	0	0
3.95–4.04	0	2

Figure 3 is a graphic representation of the arrangement in classes of the ratios of length to width of the conidia and the limits of variation for the Philippine *Curvularia.*

Germination of conidia. The conidia from field materials and from pure cultures germinated readily in sterile distilled water, gladiolus decoction, and dilute potato-dextrose agar (diluted twice its volume with sterile distilled water) in Van Tieghem cells.

Mature conidia produced a germ tube from one end or one from each end of each spore in 35 minutes to 6 hours, depending upon the age of the spores (Pl. II, fig. 6). At room temperature, they germinated faster in sterile distilled water, the lengths of the germ tubes measuring 4 microns after one hour, 47 microns after two hours, 100 microns after three hours, and double that length, or even longer, after five and one-half hours. Broken conidia and conidiophores from field specimens germinated in dilute potato-dextrose agar.

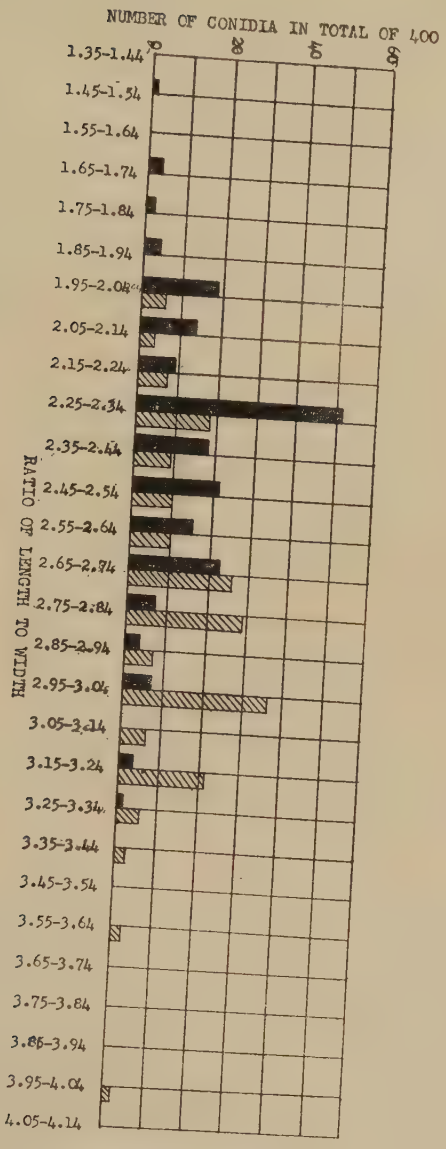


Fig. 3.—Arrangement in classes of the ratios of length to width of conidia of the Philippine *Curvularia*, showing the limits of variation.
■ = ratios of length to width of conidia from the host.
▨ = ratios of length to width of conidia from the culture.

Behavior of the fungus on different media

The growth of the fungus was studied in plate and slant cultures. Small bits of the fungus from pure culture were transferred to 22 different media and substrata, namely: water agar, nutrient agar, corn-meal agar, potato-dextrose agar, gladiolus decoction, steamed gladiolus leaf, potato cylinders, steamed oatmeal, steamed rice, steamed corn meal, lima-bean agar, onion agar, oatmeal agar, Czapek's nitrate-solution agar, malt agar, sugarcane-dextrose agar, nutrient-dextrose agar, sweet potato-dextrose agar, sweet potato-decoction agar, and sterile pieces of cloth, cotton, and filter paper dipped in gladiolus decoction and placed in tubes.

The fungus grew rapidly and produced comparatively dense growth and abundant spores on most of the media and substrata used, except on water agar and nutrient agar where the growth was thin, or very scanty, and very few spores were produced. Likewise, on filter paper and cloth the growth was thin, but many spores were formed. On absorbent cotton, the growth was also thin and very few spores were produced. In general, on most of the media used the growth was at first dirty white, then gray, with traces of pink or purple. It became black (olivaceous black) with a trace of purple after a few days as sporulation, production of submerged thick-walled hyphal cells, and maturity of the mycelium occurred. The growth was especially dense on potato-dextrose agar, oatmeal agar, potato cylinders, steamed rice, and steamed oatmeal; medium dense on gladiolus decoction, gladiolus-decoction agar, onion agar, lima-bean agar, nutrient-dextrose agar, malt agar, Czapek's nitrate-solution agar, sugarcane leaf-dextrose agar, and sweet potato-decoction agar; thin and submerged on nutrient agar; thin and fluffy on filter paper and cotton cloth; very thin and fluffy on absorbent cotton; and very thin on water agar.

Inducing the production of the ascigerous stage

Infected parts of gladiolus were exposed outdoors. Some infected plants were left in pots of soil and others in empty bottles placed out-of-doors for an indefinite period of time. Cultures 17 days old, growing on different media and substrata, were subjected to different treatments and environmental conditions, such as (*a*) treating the cultures for a few seconds with fumes of formaldehyde and incubating them at room temperature after the treatment; (*b*) taking care that the cultures were not contaminated, by constant removal of the superficial growth of the fungus, and incubating them at room temperature; (*c*) placing vigorous cultures in a desiccator to remove moisture and incubating them before they were completely desiccated; (*d*) subjecting cultures to high temperature, by immersing the test tube cultures in boiling water for a few seconds, and incubating them afterwards; (*e*) subjecting the cultures to low temperature by placing them in an ice box at varying lengths of time; (*f*) treating the cultures with dilute solution of mercuric chloride

solution for a few seconds; and (*g*) covering the cultures with melted paraffin and incubating them afterwards. In all cases, the fungus did not produce perithecia, although mycelium, conidia, and thick-walled hyphal cells were produced after several months.

Influence of hydrogen-ion concentration on the growth of the fungus

The pH values of test tubes of potato-dextrose agar were adjusted between pH 2.8 and pH 8.6, and the agar was poured in sterile Petri dishes and planted to small bits of the fungus growth from pure culture after the agar had thoroughly solidified. The plates were incubated and the daily growths of the fungus for five days were measured. The result, as given in table C, shows that good growths occurred at pH values from 4.4 to 8.6.

TABLE C

Growth of the Philippine Curvularia on potato-dextrose agar of varying hydrogen-ion concentrations

pH VALUES	INITIAL SIZE OF THE FUNGUS PRODUCED	AVERAGE GROWTH IN mm. AFTER	
		3 days	9 days
	mm.	*mm.*	*mm.*
2.8	3.0	3.0	3.0
3.0	3.0	3.0	3.0
3.2	3.0	4.0	5.0
3.6	3.0	5.0	13.0
4.4	3.0	18.0	40.0
4.9	3.0	20.0	58.0
5.2	3.0	23.0	60.0
5.4	3.0	23.0	75.0
5.6	3.0	21.5	74.0
6.0	3.0	20.0	69.0
6.2	3.0	20.0	68.0
6.4	3.0	18.0	68.0
6.8	3.0	18.0	58.0
7.8	3.0	18.0	55.0
8.4	3.0	18.0	55.0
8.6	3.0	17.5	41.0

The growth was abundant from pH concentration of 4.9 to pH concentration of 6.8; the best growth was at pH concentrations of 5.4 and 5.6; there was no growth at pH concentrations of 2.8 and 3.0. There was very little growth at pH 3.2. The changes in reaction of the medium did not induce the fungus to produce perithecia either.

Spore dissemination

To determine whether or not conidia of the fungus are carried in the air, causing secondary infection, Petri dishes with sterile potato-dextrose agar which had been allowed to congeal were exposed for five minutes over flowering gladiolus plants near infected ones.

Microscopic examinations of the plates after three days of incubation in the laboratory revealed that spores of *Curvularia lunata* (Wak.) were among the spores caught. The others were those of *Fusarium, Acrothecium, Aspergillus,* and *Diplodia.* Transfers of the *Curvularia* were made to test tubes of slant agar, allowed to grow, and compared with isolates from diseased gladiolus parts. The cultures from the spores caught in the plates compared favorably with the isolates under study.

Pathogenicity

Various methods of inoculation were tried for testing the parasitism of the *Curvularia* isolated in pure culture. In each inoculation a control was used.

Experiment 1. On July 3, 1951, one-month-old potted gladiolus plants of the varieties Picardy and Margaret Beaton were sprayed thoroughly on the wounded and unwounded parts with the spore-suspension of a ten-day-old culture of the fungus.

Experiment 2. On July 3, 1951, another set was inoculated with bits of mycelium on different parts of the leaves. Each set was provided with a control lot. After two days the inoculated plants showed infection, more clearly on the wounded parts of the leaves. On the third day, all the plants inoculated were infected, but the checks remained healthy. Four days after inoculation, the lesions were many and of varying sizes.

Experiment 3. On September 29, 1951, healthy, blooming plants of the same varieties were also sprayed with the spore-suspension on the flowers and on the wounded and unwounded parts of the leaves. The flowers were the first to succumb to the disease. Infection was shown by more or less circular water-soaked areas, which became blackish four days after inoculation.

Experiment 4. On July 28, 1951, sterilized soil in pots were inoculated with the fungus growth, and in them were planted healthy corms from healthy plants of the two varieties, Picardy and Margaret Beaton, which had been disinfected for two hours with 1:1000 mercuric bichloride solution and washed thoroughly in running water. After 22 days, 100 per cent of the plants which grew in the inoculated soil showed signs of infection on parts a little below or above the ground level. The spots were elongate, sunken, and black. The infected parts rotted and this condition caused the plants to lodge or fall over. The checks remained healthy and reached maturity.

Experiment 5. On December 20, 1951, healthy or perfectly clean corms from healthy plants were disinfected with 1:1000 mercuric bichloride solution for two hours and thoroughly washed in running water. They were placed separately in sterile covered dishes which served as damp chambers, and bits of the fungus growth from pure culture were placed on the wounded and unwounded parts of one set of corms. As control, no fungus growth was placed on the

wounded and unwounded parts of the other set. After four or five days, infection was shown by the wound-inoculated corms and very slight change by the unwounded ones. The wounded and inoculated parts became brown and were soon covered with the gray fungus growth, whereas the unwounded ones became brownish and had only little fungus growth on them. The disease progressed slowly, being confined to the brown spots on the corms. In both cases, the checks remained healthy.

In all inoculations, the fungus was reisolated and reinoculations were made. The second isolates compared favorably with the first isolates.

The diseased corms were stored, disinfected before planting by dipping in 1:1000 mercuric chloride solution for two hours, and washed in running water. Some were planted in pots of sterilized soil and others placed in a damp chamber for two to three days. Some of the seriously diseased potted corms rotted, whereas the slightly infected ones produced healthy plants which later succumbed to the disease. Those in the damp chamber produced conidiophores and conidia. The experiments conducted afford sufficient evidence of the pathogenicity of the isolated fungus and of the uselessness of dipping already infected corms into fungicide solutions. To prove this further, infected corms from infested fields were planted in garden soil in pots after they had been disinfected. The result of this planting was that no plant was found free of the disease.

Taxonomy

The Philippine gladiolus spot fungus is closest to *Curvularia lunata* (Wakker) Boedijn (*Acrothecium lunatum* Wakker) (Gilman, 1945), the basic and best known species of Boedijn (1933). The writer considers the Philippine species of *Curvularia* identical with *Curvularia lunata* (Wakker) Boedijn, although there is a slight discrepancy between them in the size of the spores, mycelium, and conidiophores, perhaps because of the different media used, techniques followed, and climatic conditions obtaining in the Philippines and in the United States. The discrepancy, however, is not of taxonomic significance.

LIFE HISTORY OF CURVULARIA LUNATA IN RELATION TO THE PRODUCTION AND DEVELOPMENT OF THE DISEASE

Seasonal occurrence and severity. The disease is more prevalent during the wet season, from September to December, and is absent during the dry season. Its severity is influenced by warm and moist weather conditions which prevail during the rainy season. In Florida, Magie (1948) observed that the disease is favored by moist weather and a temperature above 58°F. (14.4°C.). In 1951, the same author found that the disease was severe where plantings were insufficiently protected with spray during the wet months of September and October.

Source of inoculum and infection in the field. The fungus is carried in the corm as mycelium. Infected corms which are planted on land that has not been planted to gladiolus may either grow or rot. When the corms rot, the fungus is incorporated into the soil where it establishes itself and tends to accumulate from year to year. When clean stocks of gladiolus corms are planted in this infested soil the following season, the disease is reproduced, and the plants which are able to grow and escape infection may become infected by the spores which are carried by air currents from the soil or from the diseased plants.

Method of penetration. All the inoculation experiments show that the fungus is capable of penetrating uninjured and injured leaves and corms.

How the fungus withstands adverse conditions. After harvest, diseased leaves, flowers, corms, and other plant parts left on the ground rot. The organism in the rotted material is returned to the soil where it remains in the form of spores and thick-walled hyphal cells until the next planting season. Gilman's (1945) finding of *Curvularia lunata* (Wakker) Boedijn in the soil is corroborated by the writer who found that the fungus is capable of withstanding desiccated conditions and remaining alive for more than nine months. When healthy corms of susceptible varieties are planted in the same field the following season, most of them become infected with the disease. Corms from infected soil also become diseased when planted in soil which has never been planted to gladiolus before.

CONTROL MEASURES

The results of the present experiments and study of the disease and its causal organism suggest the following measures for preventing the incidence of the disease:

1. Use of disease-free corms from healthy plants in fields where the disease has not yet occurred. The observance of this measure will prevent the introduction of the disease in a new field.

2. Treatment of apparently healthy corms by soaking or dipping them in 1:1000 mercuric chloride solution for two hours or dusting them with Fermate until they are suitably covered. Experiments showed that dipping or dusting is effective for apparently healthy corms. The treatment is of no value to corms which are already diseased. The treated diseased corms always produce diseased plants which do not reach maturity because they continue to rot. Seed treatment does not control the disease completely, though it reduces infection considerably.

3. Planting of treated apparently healthy corms in well-drained soil which has never been planted to gladiolus before. Smith [7] recom-

[7] SMITH, RALPH E. 1940. Diseases of flowers and other ornamentals. California Agric. Extension Serv. Cir. 118: 1–108. *Fig. 1–40.*

mended planting in a soil which has not been planted to gladiolus for at least four years.

4. Handling of gladiolus corms properly. When the corms are mature they should be dug, sorted, husked, cured, and stored carefully. All discarded corms and husks should be burned or buried. Before planting, the corms should be resorted, husked further, and treated. The husks and corms that developed the disease in storage should be destroyed. Bruises on the corms should be avoided as they afford avenues for entrance of the causal organism and other pathogens.

5. Crop rotation. Since *Curvularia lunata* (Wakker) Boedijn can remain as a saprophyte, capable of remaining alive in the soil for some time, crop rotation should be practiced so as to starve the parasite.

6. Spraying or dusting of new growths with fungicide when the plants are planted during the rainy season. The spraying or dusting should be repeated from time to time as new growths appear. Magie, in 1948, found dithane and parzate sprays as the most promising fungicides against *Curvularia* spot in Florida. He recommended a five- to eight-day schedule to protect the leaves and a three-day schedule to protect the spikes. In 1951, he reported zineb (nabam plus zinc sulfate) as a new fungicide for *Curvularia* disease. Plantings of Picardy cormels partially killed by the disease were saved by spraying with the new fungicide as frequently as every day for a week, then two or three times each week, during the time the leaves were growing. The writer dipped the corms in 1:1000 mercuric chloride for two hours in a glass container, washed them thoroughly in running water, dried them afterwards, and then dusted them with Fermate. This treatment reduced the infection considerably.

7. Use of resistant varieties. Of the five varieties that the writer planted, Jonquil and two others (salmon- and violet-colored varieties) were not infected. Planting these varieties in infested soil will help control the disease.

8. Planting of gladiolus during the dry months of the year (February to March).

SUMMARY

1. The *Curvularia* spot is a new disease of gladiolus in the Philippines. It is prevalent during warm days in the wet season and causes severe spotting of the stems, leaves, spikes, stipules, flowers, and even the corms. The characteristic spots are circular and elongate on the leaves, irregular on the flowers and corms, and elongate on the spikes and stipules. On the leaves, they are pale yellow at first; then the central portion turns orange-cinamon and becomes sunken. Each spot is surrounded by a Mikado brown ring and the whole lesion is separated from the healthy tissue by a light yellow halo. When weather conditions are favorable, the spots be-

come deep mouse black because of the production of conidiophores and conidia by the causal fungus.

2. The disease is caused by the fungus *Curvularia lunata* (Wakker) Boedijn. The fungus is easily isolated from the diseased tissues by tissue-culture and single-spore methods. It has a simple morphology consisting only of mycelium, conidiophores, and conidia. The mycelium is smooth, septate, and branched. At first it is hyaline, then it becomes dark olive gray. The conidiophores are simple, septate, erect, and are borne in groups of two to nine on the host tissues and singly in culture. They have geniculations and bear scars at moderate intervals. They measure 90.95 microns by 4.3 microns. The conidia are produced abundantly on the host tissues on most of the media except water agar, nutrient agar, and absorbent cotton. They are typically curved and 3-septate. The third cell from the base is distinctly larger and darker than the terminal cells, and each spore has a hilum at the basal portion. The conidia are borne terminally and laterally on the geniculations on the upper portion of the conidiophores. They are hyaline when young and light olive gray to dark olive gray when fully formed. They measure 27.5 $\times$ 10.8 microns and germinate by the production of a germ tube from one or both ends.

3. The fungus produces dense growth of mycelium and abundant spores on most of the media and substrata used, except on water agar, nutrient agar, and absorbent cotton. The growth is at first dirty white, then gray, with traces of pink or purple, and then black (olivaceous black) because of sporulation and production of submerged thick-walled hyphal cells. The growth of the fungus is most abundant at pH concentrations of 5.4 and 5.6 and is absent at pH concentrations of 2.8 and 3.0.

4. Diseased plant parts left in the field return the fungus to the soil where it becomes the source of infection. The organism is also spread by conidia to healthy plants by air. The spores germinate readily and penetrate the leaves and other plant parts with or without wounds.

5. The occurrence of the disease may be prevented by using only healthy corms for seed; treating these corms by soaking or dipping them in 1:1000 mercuric chloride solution for two hours or by covering them with Fermate; planting them in well-drained soil which has never been planted to gladiolus before; covering the new growths with fungicide and repeating the application as new growths appear; handling gladiolus corms properly, burning or burying the husks and diseased corms to reduce sources of inoculum; practising crop rotation; and using resistant varieties whenever possible.

LITERATURE CITED

BOEDIJN, K. B. 1933. Ueber einige Phragmosporen Dermatiazen. Bull. Jard. Bot. Buitenzorg (3) 13 (1): 120–134. (Original article, not seen).

GILMAN, JOSEPH C. 1945. A manual of soil fungi. xi + 392 p., 135 fig. Ames, Iowa: The Iowa State College Press.

MAGIE, R. O. 1948. Curvularia and other important leaf and flower diseases of gladiolus in Florida. (Vegetable Crops Laboratory, Bradenton, Florida. Florists' Exchange **110** (4): 12, 53). *Abstract by Philip Brierly.* Biological Abstracts **22** (6): 1469.

————. 1948. New gladiolus disease termed threat to Florida industry. (Agric. Exper. Sta., Gradenton, Florida. Florists' Review **101** (2616): 35–36). *Abstract by C. W. Fischer.* Biological Abstracts **22** (10): 2570.

————. 1951. Etiology and control of certain epiphytotic diseases of gladiolus. Florida Agric. Exper. Sta. Ann. Rept. State Project **506**: 217.

PADWICK, G. WATTS. 1948. Plant protection and the food crops of India. I. Plant pests and diseases of rice, wheat sorghum and grain. Empire Jour. of Exper. Agric. **16**: 55–64.

RIDGWAY, ROBERT. 1912. Color standards and color nomenclature. iii + 43 p., 53 pl. Washington, D.C.: Robert Ridgway.

TAUBENHAUS, ALTSTATT, AND WYCHE. 1935. Black kernel of rice. Texas Agric. Exper. Sta. Ann. Rept. **48**: 94.

TULLIS, E. C. 1936. Fungi isolated from diseased discolored rice kernels. U. S. Dept. Agric. Tech. Bull. 540: 1–2. *Fig. 1–4.*

WARDLAW, C. W. 1935. Diseases of the banana and of the Manila hemp plant. xii + 615 p. London: MacMillan and Co.

DESCRIPTION OF PLATES

PLATE I

Fig. 1. Leaves and spikes of diseased gladiolus plant showing the typical symptoms of *Curvularia* spot.

Fig. 2. Diseased spikes showing the damage to flowers and stipules. (*Photographed by Mr. Valera of the Photographic Division, College of Agriculture and Central Experiment Station*).

PLATE II

Fig. 1. Camera lucida drawings of 2½-month-old mycelium. Hyphae are dark olivaceous.

Fig. 2. Camera lucida drawings of conidiophores from the host, showing groupings, septation, and geniculations.

Fig. 3. Camera lucida drawings of conidia from the host, showing typical shape, septation, and hilum and the little difference in size.

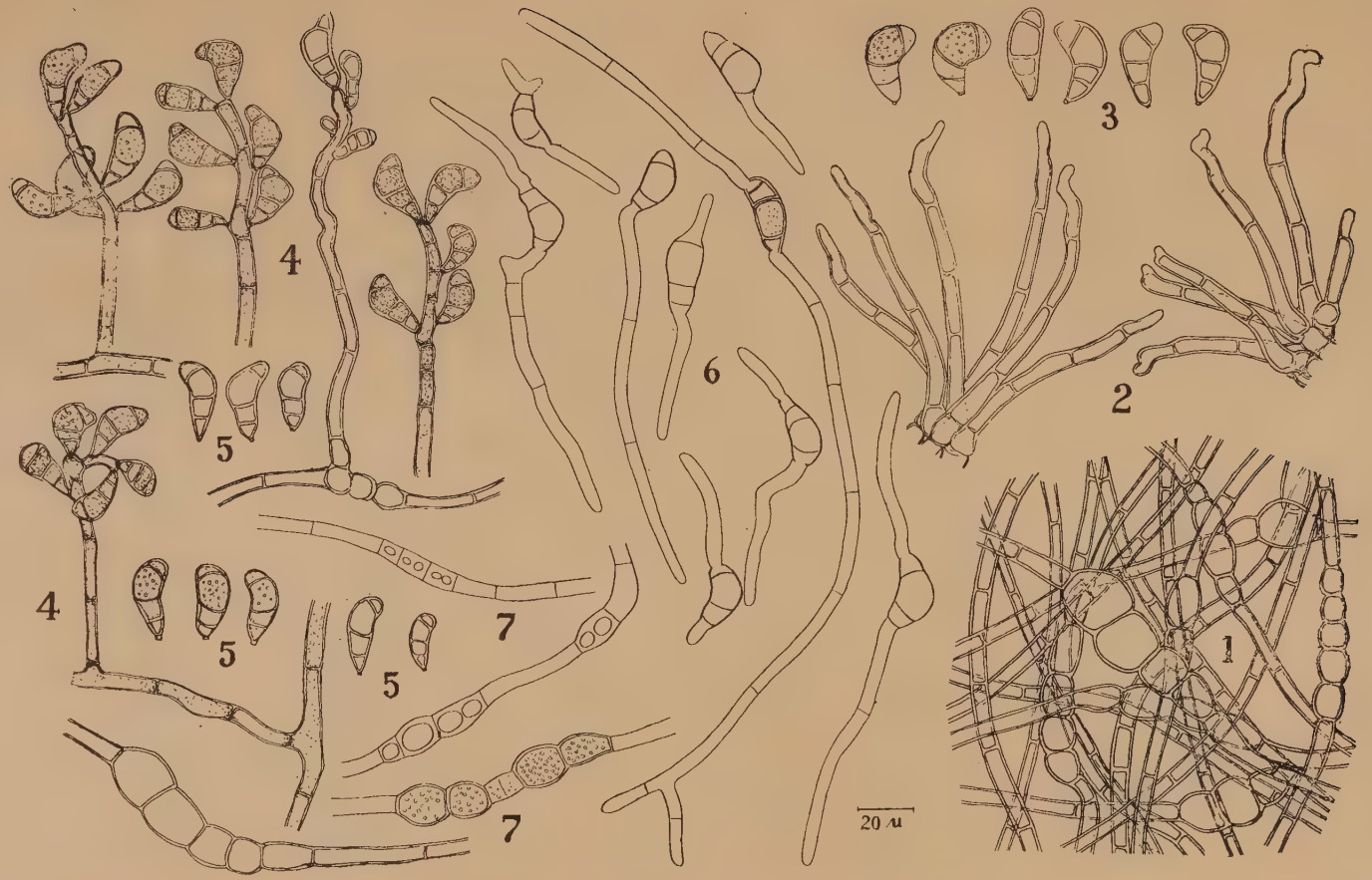
Fig. 4. Camera lucida drawings of conidiophores from culture, showing formation of hyphae from the side and tip, septation, and conidia still attached.

Fig. 5. Camera lucida drawings of conidia from culture, showing typical shape, septation, and hilum and the little difference in size.

Fig. 6. Camera lucida drawings of germinating conidia in sterile distilled water.

Fig. 7. Camera lucida drawings of thick-walled resting hyphal cells taken from a 7-day-old agar culture.

MENDIOLA–ELA: CURVULARIA DISEASE OF GLADIOLUS



MENDIOLA–ELA: CURVULARIA DISEASE OF GLADIOLUS

THE INFLUENCE OF VARYING AMOUNTS OF FERTILIZER AND LEVELS OF MOISTURE SATURATION ON YIELD OF ELON-ELON AND ININTIW STRAIN 107 [1]

LEONARDO A. ABARRA

WITH FOUR TEXT FIGURES

With the object of understanding the relative effects of the level of moisture saturation and the amount of ammonium sulfate on the development and yield of rice, experiments were conducted in the Department of Agricultural Botany and Department of Agricultural Engineering of the Central Experiment Station of the College of Agriculture, Los Baños, Laguna, from June, 1951, to January, 1952.

MATERIALS AND METHODS

Los Baños clay loam, taken from the experimental lot behind the Agricultural Botany building, was pulverized, sieved, air-dried, and thoroughly mixed. The water-holding capacity of this soil was found to be 47.13 per cent on the air-dry basis and 63.47 per cent on the oven-dry basis. Seventeen kilograms of the air-dry soil were placed in each of 128 tarred 5-gallon kerosene cans.

Sixty-four culture cans were planted to Inintiw Strain 107, an upland variety of rice, on July 5, 1951. Another 64 cans were planted to Elon-elon, a lowland variety of rice, on June 27, 1951. Two plants were maintained about 20 centimeters apart in each can.

The cans of both the Inintiw and the Elon-elon lots were divided into four groups of 16 cans each (table 1). Group I of each lot was maintained at 50 per cent saturation; group II, at 70 per cent; group III, at 90 per cent; and group IV, at 110 per cent. Each group was in turn divided into four cultures of four cans each. Culture 1 received no fertilizer (control); culture 2 received 0.576 gram of ammonium sulfate to a can (100 kilos a hectare); culture 3, 1.15 grams (200 kilos a hectare); and culture 4, 2.30 grams (400 kilos a hectare).

The cultures were placed on a table with rollers which could be pushed in the shade during rainy weather and out during fine weather. Every week, water was added to the cultures in order to restore the amount lost by evaporation. The cultures were weeded from time to time, and insect pests found attacking the plants were hand-picked and killed.

[1] Central Experiment Station Contribution No. 1653. Thesis presented for graduation with the degree of Bachelor of Science in Agriculture from the College of Agriculture. Prepared in the Departments of Agricultural Engineering and Agricultural Botany under the direction of Associate Professor A. P. Aglibut and Dr. J. P. Velasco.

Note was taken of the date when the majority of the plants bloomed. When the majority of the grains turned yellow, the grains from each can were harvested, placed in paper bags, sun-dried, and weighed.

RESULTS AND DISCUSSION

External appearance of the plants. During the early part of the experiment, there was no conspicuous difference in the vegetative growth of the plants of both varieties in each group of cultures, but two weeks after the application of fertilizer, there was a slight difference in color between the fertilized and unfertilized plants. As the plants grew older, the developmental differences became more striking. The fertilized plants produced more tillers with dark green leaves than the control or unfertilized plants. As the amount of fertilizer was increased, the green color of the leaves was intensified, thus corroborating the findings of Talamisan.[2] This striking peculiarity was noted distinctly in the cultures with lower moisture levels.

Fifty days after planting, temporary wilting during the noon hours was noticed in the cultures which received fertilizer at the rate of 200 kilograms and 400 kilograms a hectare in the 50 per cent moisture level group. This was primarily due to the inadequate amount of moisture in the soil four to five days after the original level had been restored. Besides, the amount of water lost through transpiration in cultures 3 and 4 was perhaps greater than in cultures 1 and 2 on account of the better growth of the plants resulting from the use of a relatively higher concentration of fertilizer. This wilting was only temporary, however, as it disappeared when the original moisture level of the culture was restored.

Susceptibility to pests and diseases. From the early stages of growth to the booting stage of both varieties, a random attack of the larvae of *Cyllo leda* Cramer and *Hesperia philino* Morchl [3] was noted. These insect pests were not able to do much damage because they were picked constantly. The cultures were transferred inside a screened experimental compartment at the flowering stage and were kept there up to harvest time, thus preventing the attack on the grains of whatever pests there were.

Comparative ages of blooming and maturity. In general, both varieties grown in 90 and 110 per cent soil moisture saturations flowered and matured earlier than those in the 50 and 70 per cent levels (table 1). Inintiw strain 107 grown in the 90 per cent level matured earlier than the cultures in the 110 per cent level and very much earlier than those in the 70 per cent level. The cultures in the 50 per cent level matured the latest. This finding corroborates

---

[2] TALAMISAN, BENIGNO C. 1938. Should superphosphate be added with ammonium sulphate to Lipa clay loam for upland rice? Philippine Agriculturist 27: 284–301. *Fig. 1–3.*

[3] Determination by Dr. S. M. Cendaña of the Department of Entomology.

that of Palis,[4] which stated that 90 and 80 per cent saturations were conducive to early ripening of grains of upland rice plants, variety Kinandang Pute, grown in pots, and that percentages of saturation above 90 and below 80 per cent caused noticeable delay in maturity.

The cultures of Elon-elon in 110 per cent saturation flowered and matured ahead of the cultures in the other levels of moisture saturation (table 1). This result showed that when the amount of

Fig. 1.—Flowering stage of Inintiw strain 107 grown in Lipa clay loam soil containing different amounts of water and ammonium sulfate, as shown on the labels. (*Photographed by the Photographic Division*)

water applied was decreased, the flowering and maturity of the plants were delayed. Within a group of moisture saturation, greater amounts of ammonium sulfate fertilizer delayed the flowering and

[4] PALIS, GUILLERMO O. 1935. A study of the effects upon the growth and development of an upland rice of varying the moisture content of soil in pots. Philippine Agriculturist 24: 394–413. *Fig. 1–4.*

maturity of both rice varieties. The application of 200 and 400 kilograms of fertilizer a hectare caused a noticeable delay in flowering and maturity. With Inintiw strain 107, the delay ranged from one to three days over that of the control cultures; with Elon-elon, it was one to five days.

Fig. 2.—Flowering stage of Elon-elon grown in Lipa clay loam soil containing different amounts of water and ammonium sulfate, as shown on the labels. (*Photographed by the Photographic Division*)

Height and number of bearing culms. The comparative heights of Inintiw strain 107 plants grown in different culture groups are presented in table 4 and figure 1. In the 70 per cent saturation level, an increase of fertilizer apparently gave a corresponding increase in the height of the plants. The comparative heights of Elon-elon plants were influenced by the amount of fertilizer applied in the different moisture saturation levels (table 5 and fig. 2). The response of Elon-elon was practically the same as that of Inintiw strain 107, except in the 110 per cent level where the fertilized plants were shorter than the plants in the corresponding cultures in the lower moisture saturation levels.

The highest mean number of bearing culms of Inintiw strain 107 was obtained from cultures 2 to 4 in group I, which contained 50 per cent moisture (table 2). In the higher saturation levels of lots with corresponding amounts of fertilizer, the mean number of bearing culms decreased.

In the case of Elon-elon, the number of bearing culms, with a few exceptions, increased with the increase in moisture (table 3). At higher moisture levels of 70, 90, and 110 per cent, the mean number of bearing culms increased as the fertilizer applied was increased. In the 50 per cent level, however, the number of bearing culms decreased when the amount of fertilizer exceeded 100 kilograms a hectare.

Yield of straw. Table 6 shows that in all cases, the application of fertilizer resulted in an increase in yield of straw of Inintiw strain 107. The yield of straw of Elon-elon also increased as the amount of ammonium sulfate applied in all moisture levels was increased (table 7).

Yield of grains. The increase in fertilizer applied in any of the groups of moisture saturation of Inintiw strain 107 was followed by a corresponding increase in yield of grains (table 8a). This increase in yield varied with the different soil moisture contents. All fertilized plants in the different moisture saturation levels produced higher yield (except between cultures 1 and 2 in groups I and IV) than the unfertilized plants. The yield of grains was highest when fertilizer equivalent to 400 kilograms a hectare was applied in the 50 per cent saturation moisture level. Also, the fertilized plants in this moisture saturation level gave higher yield of grains than the corresponding fertilized plants in the other levels. This seems to be in accord with the finding of Wyche and Cheaney [5] that the application of ammonium sulfate on dry soil produced higher yield of rice than the same treatment on either wet or flooded soil.

The effects of moisture and fertilizer and their interaction were significant. The greatest variation, however, was derived from fertilizer application (table 8a, analysis of variance). The average

[5] WYCHE, R. H., AND R. L. CHEANEY. 1951. The efficiency of fertilizer application on dry, wet and flooded soils as measured by rice yields. Texas Agric. Exper. Sta. Prog. Rept. 1935.

weights of the grains in the different cultures are plotted in figure 3 to show the relative effects of fertilization and levels of moisture saturation on yield. The fertilizer had marked effects in the lower levels of saturation, especially in the 50 per cent level, but in the

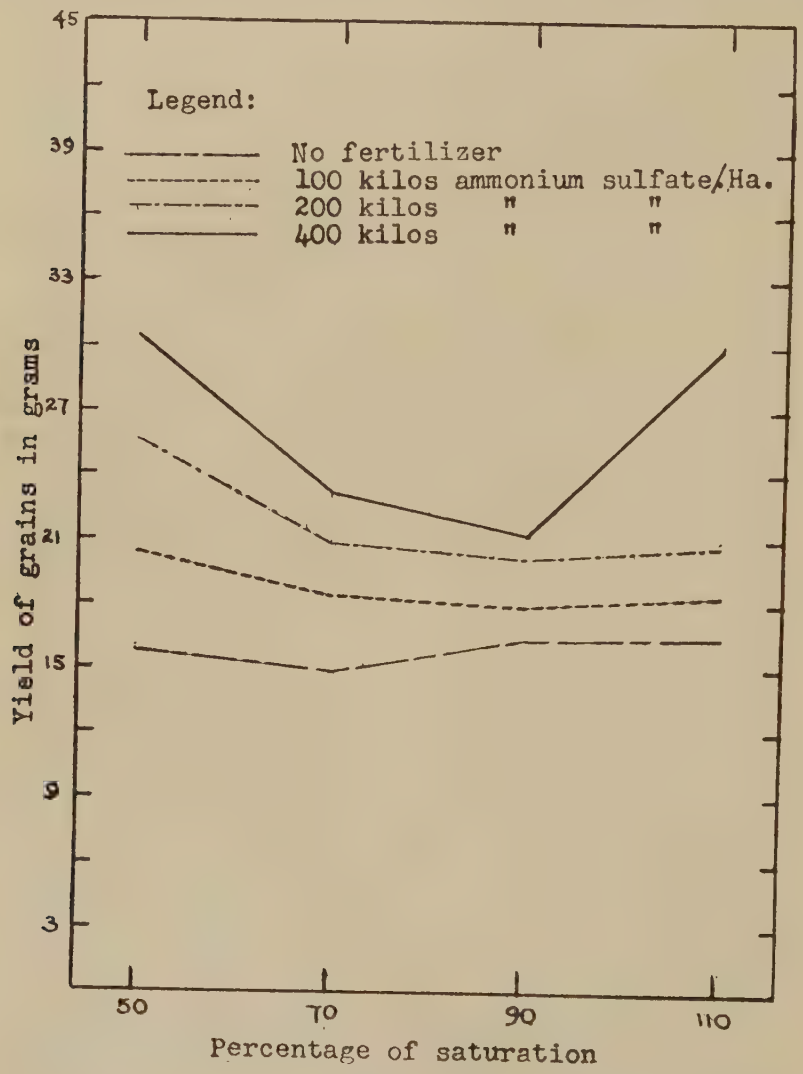


Fig. 3.—Effect of soil moisture saturation on the yield of Inintiw strain 107.

higher moisture levels, the beneficial effects of the fertilizer tended to diminish. This may mean that upland rice culture in the drier regions will benefit most from nitrogenous fertilizer application,

whereas fertilization of upland culture in the rainy regions may not be economically advisable.

The plants in the 110 per cent saturation level produced the most empty grains, and those in culture 4 in 50 per cent saturation and culture 1 in 90 per cent saturation produced the least (table 8b). As a group, however, the plants in the 50 per cent saturation level had the least empty grains.

Table 9a shows the yield of grains of Elon-elon in the different cultures. The cultures in 110 per cent saturation produced heavier yield than the corresponding cultures in the other groups. There was also an apparent increase in yield as the amount of ammonium sulfate was increased; the increases, however, were not significant. Only the effect of moisture and the interaction between moisture and fertilizer were significant.

Figure 4 shows that at 50 per cent saturation, application of fertilizer can be deleterious, as it was in the 400-kilo-a-hectare culture. Water shortage may therefore be one of the reasons why certain applications of ammonium sulfate in the field elicited very low yields. At higher moisture saturations the fertilizer had minute, insignificant beneficial effects. The general increase in yield with increase in moisture saturation, regardless of fertilizer treatment, was most striking in Elon-elon.

Table 9b gives the relative percentages of empty grains as influenced by the different fertilizer treatments. The amount of empty grains decreased as the amount of water was increased. In the same soil saturation level, an increase in ammonium sulfate was accompanied by a corresponding increase in empty grains.

Water requirement of Elon-elon and Inintiw strain 107. In this study, the term "water requirement" was taken to mean the cubic centimeters of water required to produce a unit yield of grains and straw. It was observed that the amount of water which evaporated increased as the plants grew older but gradually decreased as they reached maturity. It was also observed that at the tillering stage, the amount of water required was greater than at the booting stage. These findings concur with the finding of Palis [6] that the water requirement of 40-day-old rice plants was greater than that of full-grown plants. It was noted that as the amount of ammonium sulfate applied in the same percentages of soil saturation was increased, the total amount of water added to each can was also increased, (tables 10 and 11), probably because of the bigger size of the plants which received more fertilizer.

The water requirements of Inintiw strain 107 and Elon-elon are given in tables 10 and 11. Judged by the results obtained in this experiment, the best amount of water for Inintiw strain 107 to produce greater yield of grains (table 8a) when fertilized with ammo-

[6] PALIS, *op. cit.*

nium sulfate at the rate of 200 to 400 kilograms a hectare was 50 per cent of the water-holding capacity of the soil (air-dry basis). When no fertilizer was applied, however, the best amount of water

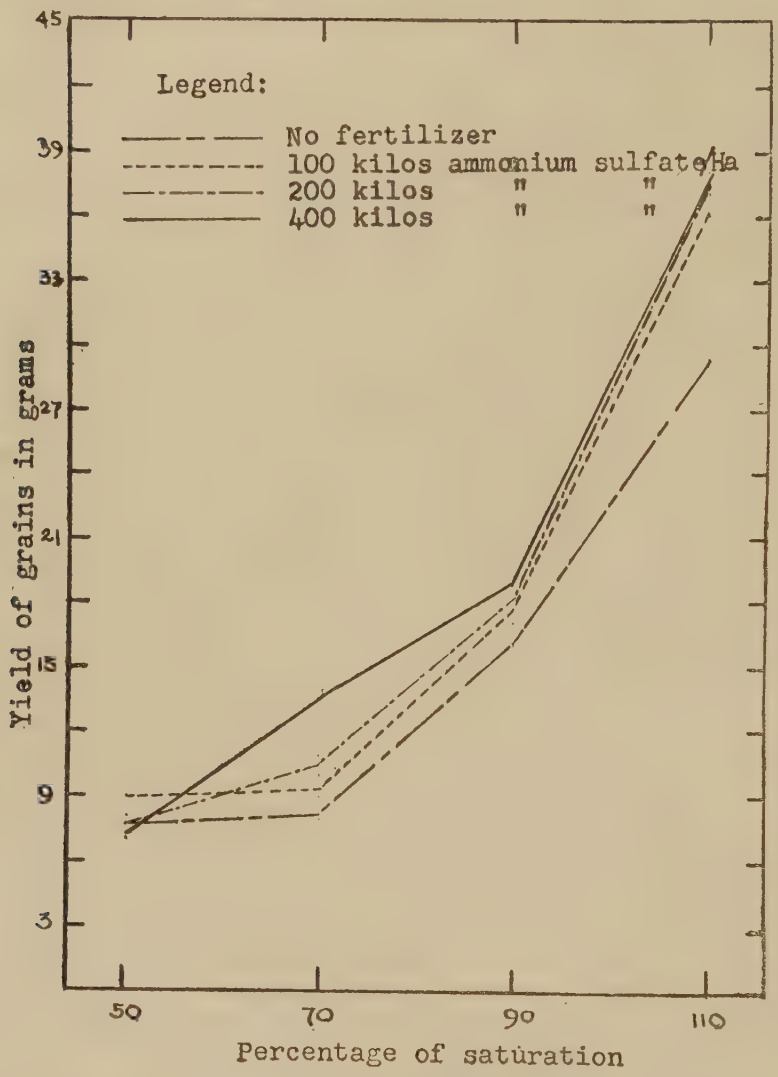


Fig. 4.—Effect of soil moisture saturation on the yield of Elon-elon.

was 90 to 110 per cent. In the production of straw (table 6), fertilized and unfertilized plants in 90 and 110 per cent saturations gave the best results, although in cultures 3 and 4, which received

fertilizer at the rate of 200 and 400 kilograms a hectare, respectively, the 50 and 70 per cent saturations also gave good results.

For Elon-elon, the amount of water which produced the maximum yields of grains (table 9a) and straw (table 7) in fertilized and unfertilized plants was the 110 per cent saturation (table 11). The cultures which were supplied with water equivalent to 50 per cent of the water-holding capacity (air-dry basis) had very low yields of grain and straw. These results show that Elon-elon, a lowland variety, requires heavier irrigation.

SUMMARY

Rice varieties Inintiw strain 107 and Elon-elon were subjected to different percentages of soil moisture saturation during their development. Within each level of moisture saturation, plants were initially supplied with varying amounts of ammonium sulfate.

Both varieties were taller and more vigorous and matured earlier at higher percentages of moisture saturation than at lower percentages. Fertilization delayed their maturity; except at 50 per cent saturation of Inintiw and 110 per cent saturation of Elen-elon, it increased their final heights.

The grain yields of Inintiw strain 107 were highly favored by fertilization, especially at 50 per cent saturation. Those of Elon-elon were highly favored by high levels of moisture saturation.

TABLE 1

Comparative ages of blooming and maturity of the plants in different cultures

GROUP NO.	MOISTURE SATURATION	AMOUNT OF FERTILIZER	ININTIW STRAIN 107		ELON-ELON	
			Time from planting to flowering	Time from planting to maturity	Time from planting to flowering	Time from planting to maturity
	per cent	*kg./ha.*	*days*	*days*	*days*	*days*
I		0	80	115	159	194
		100	82	116	159	195
	50	200	83	118	161	197
		400	83	118	164	199
II		0	80	114	157	190
		100	80	115	157	190
	70	200	81	117	158	191
		400	81	117	159	192
III		0	75	110	154	188
		100	75	110	154	188
	90	200	76	111	155	189
		400	77	113	157	190
IV		0	75	111	149	186
		100	75	113	152	187
	110	200	77	114	154	189
		400	77	114	155	189

TABLE 2

Total number of bearing culms of Inintiw strain 107 grown in Lipa clay loam

GROUP NO.	SATURATION MOISTURE	CULTURE NUMBER [a]				TOTAL
		1	2	3	4	
	per cent					
I	50	10	18	21	20	
		10	17	16	20	
		9	15	15	22	
		10	14	19	21	
Total		39	64	71	83	257
Mean		9.7	16.5	17.8	20.7	
II	70	8	8	14	18	
		12	13	16	13	
		10	14	16	16	
		11	13	14	16	
Total		41	48	60	63	
Mean		10.2	12.0	15.0	15.7	212
III	90	10	12	14	16	
		11	12	12	14	
		10	11	16	16	
		9	12	10	13	
Total		40	47	52	59	198
Mean		10.0	11.7	13.0	14.7	
IV	110	13	13	15	14	
		9	10	13	14	
		9	14	12	13	
		11	10	11	15	
Total		42	47	51	56	
Mean		10.5	11.7	12.7	14.0	196

[a] Culture number 1—No fertilizer applied.
2—Ammonium sulfate was applied at the rate of 100 kg. a hectare.
3—Ammonium sulfate was applied at the rate of 200 kg. a hectare.
4—Ammonium sulfate was applied at the rate of 400 kg. a hectare.

TABLE 3

Total number of bearing culms of Elon-elon grown in Lipa clay loam

GROUP NO.	MOISTURE SATURATION	CULTURE NUMBER [a]				TOTAL
		1	2	3	4	
	per cent					
		9	9	8	7	
		9	9	10	8	
I	50	6	8	9	6	
		7	10	5	9	
Total		31	36	32	30	129
Mean		7.8	9.0	8.0	7.7	
		7	9	8	13	
		9	8	10	13	
II	70	7	9	9	10	
		9	9	10	13	
Total		32	35	37	49	153
Mean		8.0	8.7	9.2	12.2	
		8	9	9	11	
		7	8	8	12	
III	90	9	10	12	13	
		8	10	9	12	
Total		32	37	38	48	155
Mean		8.0	9.2	9.5	12.0	
		7	10	10	13	
		7	11	10	12	
IV	110	9	10	13	14	
		9	14	13	14	
Total		32	45	46	53	176
Mean		8.0	11.2	11.5	13.2	

[a] Cultures received the same fertilizer treatments as Inintiw (table 2).

TABLE 4

Average height of Inintiw strain 107 grown in Lipa clay loam

GROUP NO.	MOISTURE SATURATION	CULTURE NUMBER				TOTAL
		1	2	3	4	
	per cent	*cm.*	*cm.*	*cm.*	*cm.*	*cm.*
I	50	116.5	110.5	109.7	110.0	
		117.7	117.2	117.5	116.5	
		116.0	119.0	115.0	114.0	
		124.8	117.0	116.5	115.0	
Total		475.0	462.7	458.7	455.5	1,851.9
Mean		118.7	115.7	114.8	113.9	
II	70	113.5	109.5	109.5	119.5	
		118.0	115.0	119.5	123.0	
		116.0	116.5	118.0	125.0	
		110.5	117.8	120.0	126.0	
Total		458.0	458.8	467.0	493.5	1,877.3
Mean		114.5	114.7	116.7	123.4	
III	90	129.7	122.0	127.8	144.8	
		137.0	136.0	143.5	147.3	
		121.6	138.0	146.2	142.5	
		129.5	132.0	136.5	136.0	
Total		517.8	528.0	554.0	570.6	3,170.4
Mean		129.4	132.0	138.5	143.6	
IV	110	133.0	153.5	143.5	141.5	
		137.0	144.7	146.0	160.5	
		138.7	146.0	161.5	163.5	
		130.2	148.0	152.2	156.5	
Total		538.9	592.2	603.2	622.0	2,356.3
Mean		134.7	148.1	150.8	155.0	

TABLE 3

Average height of trees of Silvicultura grown in kaingin soon supplied with varying amounts of fertilizer and water

GROUP NO.	NUMBER OF SATURATION	NUMBER OF TREES				TOTAL
		1.	2.	3.	4.	
	per cent	cm.	cm.	cm.	cm.	cm.
I	50	127.5 134.1 127.6 121.7	114.1 114.0 114.0 114.0	111.0 114.0 111.0 114.5	128.7 [illegible] [illegible] [illegible]	
Total Mean		508.5 127.6	456.0 114.0	450.5 112.5	498.5 [illegible]	1,913.5
II	70	132.1 130.0 133.1 138.0	132.5 121.0 144.0 120.5	120.0 132.5 120.0 132.5	130.5 [illegible] [illegible] [illegible]	
Total Mean		533.2 133.3	528.0 132.0	532.0 133.0	538.5 134.6	2,132.5
III	90	138.0 139.0 137.0 139.0	120.0 140.0 138.5 134.5	147.0 [illegible] [illegible] [illegible]	142.5 144.0 137.5 146.0	
Total Mean		553.0 138.2	533.0 133.2	588.0 147.0	570.0 142.5	2,278.0
IV	250	164.5 161.0 170.0 167.0	150.5 [illegible] [illegible] [illegible]	156.0 [illegible] [illegible] [illegible]	156.5 [illegible] [illegible] [illegible]	
Total Mean		669.0 167.2	662.0 165.5	651.5 162.9	628.5 157.1	2,611.0

TABLE 6

Weight of straw of Inintiw strain 107 grown in Lipa clay loam treated with varying amounts of ammonium sulfate in different soil moisture levels

GROUP NO.	MOISTURE SATURATION	CULTURE NUMBER				TOTAL
		1	2	3	4	
	per cent	*grams*	*grams*	*grams*	*grams*	*grams*
I	50	22.0	26.0	37.0	39.5	
		24.0	31.5	39.0	40.0	
		18.0	29.0	36.0	41.0	
		24.0	25.0	40.0	44.0	
Total		88.0	111.5	152.0	165.0	516.5
Mean		22.0	27.9	38.0	41.2	
II	70	25.0	26.5	35.0	40.5	
		20.5	26.0	38.0	36.5	
		22.0	27.5	34.0	38.0	
		20.0	35.0	38.0	42.0	
Total		87.5	105.9	146.0	157.0	495.5
Mean		21.9	26.2	36.5	39.2	
III	90	23.5	33.0	37.2	43.3	
		22.0	28.5	36.3	38.2	
		24.0	32.0	40.0	42.2	
		23.0	30.5	34.5	38.5	
Total		92.5	124.0	148.0	162.0	526.5
Mean		23.1	31.0	37.0	40.5	
IV	110	27.0	34.0	38.5	43.0	
		24.0	32.0	38.5	45.0	
		26.0	30.5	37.0	45.5	
		26.0	34.5	36.0	40.5	
Total		103.0	131.0	150.0	174.0	578.0
Mean		25.7	32.7	37.5	43.5	

TABLE 7

Weight of straw of Elon-elon grown in Lipa clay loam treated with varying amounts of ammonium sulfate in different soil moisture levels

GROUP NO.	MOISTURE SATURATION	CULTURE NUMBER				TOTAL
		1	2	3	4	
	per cent	*grams*	*grams*	*grams*	*grams*	*grams*
		60.0	70.0	88.0	94.0	
		64.0	65.0	85.0	93.0	
I	50	53.0	64.0	80.0	91.0	
		58.0	72.0	82.0	95.0	
Total		235.0	271.0	326.0	372.0	1,204.0
Mean		58.9	67.8	81.5	93.0	
		54.0	70.0	82.0	100.0	
		62.0	72.0	79.0	101.0	
II	70	61.0	77.0	80.0	96.0	
		63.0	78.0	85.0	97.0	
Total		240.0	297.0	326.0	394.0	1,257.0
Mean		60.0	74.2	61.5	98.5	
		69.0	72.0	81.0	103.0	
		59.0	74.0	85.0	99.0	
III	90	61.0	78.0	82.0	98.0	
		62.0	79.0	79.0	108.0	
Total		251.0	303.0	327.0	408.0	1,289.0
Mean		62.8	75.7	81.7	102.0	
		83.0	106.0	106.0	122.0	
		81.0	110.0	111.0	120.0	
IV	110	93.0	108.0	112.0	124.0	
		90.0	110.0	115.0	128.0	
Total		347.0	434.0	444.0	494.0	1,719.0
Mean		86.7	108.5	111.0	123.5	

TABLE 8a

Weight of grains of Inintiw strain 107 grown in Lipa clay loam treated with varying amounts of ammonium sulfate in different soil moisture levels

GROUP NO.	MOISTURE SATURATION	CULTURE NUMBER 1	2	3	4	TOTAL
	per cent	*grams*	*grams*	*grams*	*grams*	*grams*
I	50	17.0	20.5	24.1	27.6	
		16.8	21.2	25.0	32.1	
		14.5	20.1	26.4	30.5	
		14.9	19.5	27.1	31.0	
Total		63.2	81.3	102.6	121.2	
Mean		15.8	20.3	25.6	30.3	368.3
II	70	16.5	18.1	21.0	23.9	
		14.2	19.0	22.4	20.5	
		14.4	19.2	19.5	24.1	
		14.6	17.7	20.8	23.9	
Total		59.7	74.0	83.7	92.4	309.8
Mean		14.9	18.5	20.9	23.1	
III	90	17.1	17.1	22.4	22.8	
		17.5	18.4	19.7	20.2	
		16.1	17.2	19.5	21.5	
		14.2	18.6	18.7	20.9	
Total		64.9	71.3	80.3	85.4	301.9
Mean		16.22	18.0	20.1	21.3	
IV	110	17.0	20.0	18.0	21.5	
		15.7	17.4	21.0	23.6	
		15.7	18.5	22.1	23.4	
		17.3	17.7	21.5	18.5	
Total		65.7	73.6	82.6	87.0	308.9
Mean		16.4	18.4	20.7	21.9	
		253.5	300.2	349.2	386.0	1,288.9

Analysis of variance

SOURCES OF VARIATION	DF	SUM OF SQUARES	VARIANCE	COMPUTED F-VALUE	TABULAR F-VALUE .05	.01
Moisture	3	179.24	59.75	4.14	3.86	6.99
Fertilizer	3	625.19	208.40	14.45	3.86	6.99
Interaction	9	129.79	14.42	7.36	2.08	2.80
Error	48	93.93	1.96			
Total	63	1028.15				

TABLE 8b

Percentages of empty grains of Inintiw strain 107

GROUP NO.	MOISTURE SATURATION	CULTURE NUMBER				TOTAL
		1	2	3	4	
	per cent	*grams*	*grams*	*grams*	*grams*	*grams*
I	50	9.57	8.50	7.43	7.80	
		10.68	9.01	5.30	4.63	
		10.49	7.94	8.65	4.78	
		9.64	7.14	5.91	6.34	
Total		40.38	32.59	27.29	23.55	123.81
Mean		10.09	8.15	6.82	5.89	
II	70	6.33	7.65	7.67	10.81	
		7.34	8.32	8.19	10.09	
		6.10	7.69	7.87	8.23	
		8.97	9.15	9.73	10.15	
Total		28.74	32.81	33.46	39.28	134.29
Mean		7.18	8.20	8.36	9.82	
III	90	7.08	10.37	11.81	9.88	
		5.52	10.24	10.46	12.93	
		6.39	8.52	11.37	14.44	
		6.58	7.92	10.95	10.82	
Total		25.57	37.05	33.59	48.07	155.28
Mean		5.89	9.26	11.15	12.02	
IV	110	12.10	13.16	15.67	14.98	
		11.74	13.86	14.42	16.61	
		12.78	12.91	12.65	14.42	
		12.18	11.94	13.39	15.50	
Total		48.80	51.87	55.13	61.51	207.31
Mean		12.20	12.94	13.78	15.38	

TABLE 9a

Yield of grains of Elon-elon grown in Lipa clay loam supplied with varying amounts of fertilizer in different saturation levels

GROUP NO.	MOISTURE SATURATION	CULTURE NUMBER 1	2	3	4	TOTAL
	per cent					*grams*
I	50	8.3	9.3	6.8	5.3	
		6.3	10.0	9.6	8.0	
		8.2	7.6	7.0	8.4	
		8.1	9.2	7.2	7.2	
Total		30.9	36.1	30.6	28.9	126.5
Mean		7.7	9.0	7.7	7.2	
II	70	7.1	9.6	8.5	13.3	
		6.7	7.6	12.2	14.3	
		9.8	9.8	9.5	11.2	
		9.2	10.2	11.7	15.3	
Total		32.8	37.2	41.9	54.1	166.0
Mean		8.2	9.3	10.5	13.5	
III	90	15.8	18.6	18.3	18.9	
		16.0	16.9	17.8	18.8	
		17.5	17.8	18.0	20.4	
		15.1	18.8	18.7	18.0	
Total		64.4	72.1	72.18	76.1	285.4
Mean		16.1	17.8	18.2	19.0	
IV	110	27.0	34.3	36.9	38.0	
		28.0	37.6	37.2	36.5	
		32.0	34.6	38.3	38.4	
		30.4	38.5	37.8	38.0	
Total		117.4	145.0	150.2	150.9	563.5
Mean		29.4	36.3	37.5	37.7	
		245.5	290.4	295.5	310.0	1141.4

Analysis of variance

SOURCES OF VARIATION	DF	SUM OF SQUARES	VARIANCE	COMPUTED F-VALUE	TABULAR F-VALUE .01	.05
Moisture	3	7309.82	2436.61	166.78	3.86	6.99
Fertilizer	3	143.74	47.91	3.28	3.86	6.99
Interaction	9	131.53	14.61	6.52	2.08	2.80
Error	48	107.68	2.24			
Total	63	7692.77				

TABLE 9b

Percentages of empty grains of Elon-elon

GROUP NO.	MOISTURE SATURATION	CULTURE NUMBER				TOTAL
		1	2	3	4	
	per cent					
I	50	13.92	15.57	10.52	16.28	
		13.11	9.09	14.79	16.66	
		9.00	8.54	15.66	10.44	
		8.96	15.07	8.49	16.74	
Total		44.99	48.27	49.46	60.12	201.84
Mean		11.25	12.07	12.36	15.03	
II	70	6.68	10.77	10.41	13.63	
		12.31	12.50	12.93	12.57	
		12.97	12.50	11.64	13.81	
		12.82	10.53	12.61	9.00	
Total		44.78	46.30	47.59	49.01	187.68
Mean		11.19	11.57	11.89	12.25	
III	90	8.67	6.31	10.29	7.73	
		7.51	8.03	7.69	10.00	
		4.37	9.90	9.80	8.26	
		9.59	9.33	5.59	8.15	
Total		30.14	33.62	33.37	34.14	131.27
Mean		7.53	8.40	8.34	8.53	
IV	110	3.54	4.46	5.14	4.18	
		4.76	5.05	5.10	7.15	
		4.76	4.94	4.88	4.95	
		4.40	3.99	5.97	5.24	
Total		17.46	18.44	20.69	21.52	78.11
Mean		4.36	4.61	5.17	5.35	

TABLE 10

Amounts of water in cubic centimeters applied to Inintiw strain 107 from July 21, 1951, to Oct. 10, 1951

GROUP NO.	MOISTURE SATURATION [a]	RATE OF FERTILIZER IN KG. A HECTARE				TOTAL
		1	2	3	4	
	per cent					
I	50	18,640	19,686	21,230	21,305	
		18,961	19,130	21,551	21,575	
		18,510	19,827	21,319	21,629	
		18,410	19,780	21,594	21,752	
Total		74,521	78,923	85,694	86,161	325,299
Average		18,630	19,606	21,433	21,540	
II	70	21,625	23,055	23,870	25,180	
		22,340	22,109	24,623	25,570	
		21,130	23,040	23,580	25,325	
		21,597	21,845	24,695	25,445	
Total		86,692	90,049	96,777	101,520	375,134
Average		21,673	22,512	24,194	25,380	
III	90	26,365	27,761	27,365	29,175	
		25,986	27,186	27,296	29,386	
		26,155	27,935	28,735	28,125	
		25,985	27,385	28,035	28,335	
Total		104,464	110,267	111,431	115,022	441,184
Average		26,116	27,567	27,858	28,755	
IV	110	31,159	32,909	32,833	37,213	
		30,924	31,834	32,813	37,134	
		31,093	32,728	33,713	36,963	
		30,963	32,013	33,973	38,263	
Total		124,139	129,484	133,332	139,573	526,528
Average		31,035	32,371	33,334	34,893	

[a] Based on the water-holding capacity of the soil (air-dry basis).

TABLE 11

Amounts of water in cubic centimeters applied to Elon-elon rice plants from July 21, 1951, to December 8, 1951

GROUP NO.	MOISTURE SATURATION [a]	RATE OF FERTILIZER IN KG. A HECTARE				TOTAL
		1	2	3	4	
	per cent	*0*	*100*	*200*	*300*	
I	50	41,960	44,178	46,784	48,532	
		41,830	43,803	46,755	48,545	
		41,595	44,227	47,133	48,171	
		41,750	44,330	45,990	48,862	
Total		167,035	176,542	186,662	194,110	724,329
Average		41,795	44,135	46,665	48,527	
II	70	50,680	52,525	54,421	57,675	
		50,648	52,860	54,490	57,725	
		50,415	53,045	54,595	56,830	
		51,352	53,124	54,736	56,750	
Total		203,095	211,554	218,242	228,980	861,871
Average		50,774	52,888	54,560	57,245	
III	90	55,840	56,975	57,446	62,296	
		54,772	57,105	58,426	61,865	
		54,820	56,295	58,970	61,310	
		55,066	57,878	57,676	62,670	
Total		220,498	228,253	232,518	248,141	929,410
Average		55,124	57,063	58,129	62,035	
IV	110	64,418	69,193	70,856	80,981	
		64,678	69,808	70,858	79,736	
		65,118	70,858	71,641	80,046	
		65,313	71,641	72,028	80,443	

[a] Based on the water-holding capacity of the soil (air-dry basis).

INFLUENCE OF THE RATE OF SEEDING ON YIELD OF FIBER AND SEED AND ON QUALITY OF FIBER OF KENAF [1]

TOBIAS B. MANZANO

WITH ONE TEXT FIGURE

The rate of seeding is an important consideration in the production of seeds and fiber of kenaf, *Hibiscus cannabinus* Linn. Crane, Acuña, and Alonso (1946) recommended that for maximum yield of fiber for every unit of land, kenaf should be planted 8 inches apart in rows at the rate of 30 to 35 pounds of seeds to an acre (35 to 40 kilograms to a hectare). David (1948) stated that for seed production, kenaf should be planted at the rate of 15 to 30 plants a square meter, and for fiber production, 50 plants to a square meter.

To determine the influence of different rates of seeding, under certain field conditions, upon the yield of fiber and seeds and quality of fiber of kenaf, a study was conducted from May, 1951, to February, 1952, in the field and laboratory of the Division of Fiber and Oil Crops, College of Agriculture and Central Experiment Station, Los Baños, Laguna.

MATERIALS AND METHODS

Preparation of the land. Fairly well-drained clay loam soil previously planted to tobacco and jute was used. The land was thoroughly prepared by plowing twice with a tractor and once with a native plow and harrowing several times after each plowing. The field was divided into ten plots of 50 square meters each with a one-meter path between the plots.

Planting. Kenaf seeds of the *viridis* variety produced in the Central Experiment Station were used. On May 18, 1951, the five plots for fiber production were planted with a hand drill, using the following five rates of seeding at random: 275 grams (22 kilograms a hectare), 425 grams (34 kilograms a hectare), 563 grams (45 kilograms a hectare), 700 grams (56 kilograms a hectare) and 838 grams (67 kilograms a hectare) of seeds to a plot, based on 100 per cent germination. These high rates of seeding were necessary to make up for the low percentage (40 per cent) of germination of the seeds used. The planting distances were 8 inches between rows and 2 inches between hills in the row. Twenty-five rows were made in a 50-square-meter area. A planting line was used during the drilling to maintain uniform 2-inch distances between the hills.

---

[1] Central Experiment Station Contribution No. 1654. Thesis presented for graduation with the degree of Bachelor of Science in Agriculture from the College of Agriculture. Prepared in the Department of Agronomy under the direction of Associate Professor Pedro A. David and Mr. Thomas G. Flores.

The five plots for seed production were planted a day after the plots for fiber production. The planting distances in this case were 20 inches between rows and 2 inches between hills in the row. Ten rows were made in every plot.

Weeding and cultivation. Weeding of all the plots begun on May 31, 1951, was completed four days after. Cultivation was done with a trowel 12 days after planting. Cultivation and a second weeding were done on the plots for seed but not on the plots for fiber because the plants had overlapped owing to close spacing between the rows.

Counting and measuring of plants. The plants in the plots for fiber were counted when they were 67 days old and recounted 16 days after. The plants in the plots for seed production were also counted when they were 91 days old and recounted when they were 125 days old. The heights of 30 representative plants selected at random from every plot were taken 91 days after planting, and the final height measurements, during harvest time.

Pests[2] *and diseases.* To check the infestation of *Anonis erosa* Hubner, the plots were sprayed with ten grams of 50 per cent DDT powder dissolved in a gallon of water. *Monolepta bifasciata* Hornst was also found feeding on the young leaves of the plants, but this insect did not stay long. A second spraying with the DDT solution was necessary at the end of the blooming period because the plants were attacked by *Nisotra gemella* Erichson.

On August 26, 1951, a fungous disease caused by a species of *Phoma,* probably *Phoma sabdariffae* Sacc.,[3] attacked the plants. A solution consisting of 27 grams Fermate powder dissolved in 3.5 gallons of water was sprayed on the plants.

Harvesting. There were five harvests in all: first when the plants were 127 days old and then weekly thereafter until they were 155 days old. Each harvest was originally planned to include three square meters from each of the rates of seeding, but because some of the plots were badly destroyed by *Phoma* blight and insect pests, samples representing average plants were restricted to a comparatively small area.

The plants were cut at ground level with a sharp bolo, tied in bundles, and weighed. Three representative samples of 15 plants each were taken from each plot during each harvest. The leaves were removed and the bark ribbons were separated from the pith, bundled, and then submerged in a concrete tank filled with running water. Seven days after, the fibers were washed to remove the pulp and gum, dried in the sun, and weighed.

---

[2] All the insects mentioned in this study were identified by Dr. Silverio M. Cendaña.

[3] Dr. F. T. Orillo identified the disease and supplied the chemical used.

The plants in the plots for the seed production test were harvested when they had shed their leaves and the capsules had matured (174 days after sowing). Three representative samples of 15 plants each were taken from each plot. Selected plants were cut carefully just below the first-borne capsule to prevent the seeds from dropping. The capsules were threshed and the seeds were winnowed and weighed.

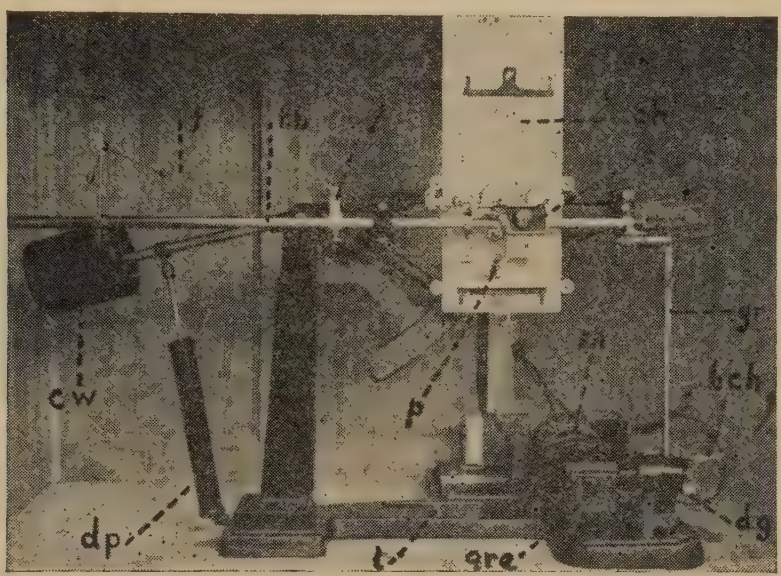


Fig. 1.—The Scott Testers IP-2 Tensilgraph machine used to determine the breaking load of kenaf fiber showing (f) fiber, (tb) tilting beam, (j) jaw, (ch) chart, (m) motor, (bch) bell crank handle, (dg) rack driving gear, (gre) gear reduction box, (l) level, (dp) dash pot, (cw) counter weight, and (p) pen. (*Photographed by Dr. Julian Banzon of the Photographic Division*)

Determination of tensile strength. A Scott Testers IP-2 Tensilgraph machine (fig. 1) was used to determine the breaking load of samples of single-fiber strands taken from the different rates of seeding and ages of plants at harvest. Five trials were made for every rate of seeding.

After the necessary adjustments had been made on the machine, a 250-gram chart was inserted in the machine such that the lower end of the chart rested on the stop pins. The pen was adjusted to coincide with the zero mark on the chart. A fiber sample was then fastened to the two jaws which were ten centimeters apart. A 250-gram carriage was used. The machine was started by pushing down the bell crank handle on the right side of the gear box. When the fiber broke, the breaking load registered on the chart was noted. The broken fiber

was cut close to the sides of the jaws with a sharp razor blade and later weighed. The operation was repeated until the required number of trials was completed.

The tensile strength was then computed by using the following formula of Botkin, *et al.* (1943) :

$$\text{Tensile strength} = \frac{\text{Breaking load}}{\text{Weight of sample per cm.}}$$

RESULTS AND DISCUSSION

Yields of the different plots. Table 1 shows that the production of fiber by a plant tended to decrease as the seeding rate was increased. The 22-kilogram-a-hectare rate of seeding had the highest mean yield of 8.65 grams to the plot and the 45-kilogram rate, the lowest of 4.86 grams. Although the number of plants in the 67-and 56-kilogram-to-the -hectare rates of seeding was greater, the yield of fiber by a plant was smaller than in the 22-and 34-kilogram rates of seeding. This decrease in the yield of fiber by a plant in the plots with greater rates of seeding may be due to the overcrowding of plants in the limited area of land used. The 45-kilogram-a-hectare rate of seeding produced the least fiber because *Phoma* blight attacked the plants and retarded their growth.

The yield of the 22-kilogram-a-hectare rate of seeding was higher than those of all the other rates of seeding. The 34-kilogram-a-hectare rate of seeding also gave a significant difference over the 45-, 56-, and 67-kilogram-a-hectare rates. The 67-kilogram-a-hectare rate gave a yield higher than that of the 45-kilogram rate, but lower than that of the 56-kilogram rate. These two, the 56- and 45-kilogram rates, did not differ significantly in yield.

The mean yield of fiber of each plant varied directly with the age at harvest. The 155-day-old plants gave the highest mean yield of 7.21 grams and the 127-day-old plants, the lowest. The yield of fiber of each plant at 155 days significantly differed from those of plants 141, 134, and 127 days old, but not from that of plants at 148 days of age. The yields of the 134-day-old plants did not differ significantly, although the 141-day-old plants gave a higher yield than the 127-day-old plants and the plants of 148 days of age gave significantly more fiber than those 127 and 134 days old.

The yield of fiber of each plant multiplied by the number of plants in the plot showed that in the 22-kilogram-a-hectare rate of seeding, there were 2428 plants; in the 34-kilogram rate, 3485; in the 45-kilogram rate, 4018; in the 56-kilogram rate, 4310; and in the 67-kilogram rate, 4978.

When the plants were harvested 127 days after planting, the 22-kilogram-to-a-hectare rate of seeding gave the highest computed yield of fiber, 21.0 kilograms; the 34-kilogram rate, 20.8 kilograms;

the 67-kilogram rate, 19.7 kilograms; the 56-kilogram rate, 19.1 kilograms; and the 45-kilogram rate, 13.1 kilograms. When the plants were harvested after 134 days, the computed yields of fiber were the following: 22-kilogram rate, 20.3 kilograms; 34-kilogram rate, 21.7 kilograms; 45-kilogram rate, 15.8 kilograms; and 67-kilogram rate, 27.1 kilograms. In plants 141 days old the highest computed yield, 30.5 kilograms, was obtained from the 67-kilogram rate, and the lowest, 20.2 kilograms, from the 22-kilogram rate of seeding. In plants 148 days old the 67-kilogram rate also gave the highest yield, 32.6 kilograms of fiber, and the 22-kilogram rate, the lowest, 21.7 kilograms. In plants of 155 days of age, the 34- and 67-kilogram rates of seeding yielded almost the same weight of fiber, 32.1 and 32.0 kilograms; the 22-kilogram rate yielded 21.9 kilograms; the 45-kilogram rate, 22.4 kilograms; and the 56-kilogram rate, 25.0 kilograms.

Table 2 shows the tendency of the plants to produce less seeds as the seeding rates were increased, though differences in yield of the different rates of seeding were insignificant. To compute the yield of seeds of each of the plots planted to different rates of seeding, the amount of seeds produced by each plant was multiplied by the number of plants in each 50-square-meter area of land. On this basis the yields of seeds in the descending order were as follows: the 34-kilogram-a-hectare rate of seeding, 30.8 kilograms; the 45-kilogram rate, 30.4 kilograms; the 56-kilogram rate, 27.6 kilograms; the 67-kilogram rate, 21.0 kilograms; and the 22-kilogram rate, 15.9 kilograms.

Height of plants as affected by the rate of seeding. Table 3 shows the tendency of the plants to grow taller as the rate of seeding was decreased. The 22-kilogram rate produced taller plants than all the others; the 34-kilogram rate of seeding gave plants taller than the 56- and 67-kilogram rates. Table 3 further shows that in the 134-day-old plants (blooming stage), the tallest plants were obtained from the lowest rate of seeding. The 34-kilogram rate of seeding gave taller plants than the 45- and 67-kilogram rates; the 56-kilogram rate was significant over the 34-, 45-, and 67-kilogram rates of seeding. The short plants from the 45- and 34-kilogram rates, shorter than those of the 56-kilogram rate, were probably the result of *Phoma* blight infection of the plots.

At 91 days of age the plants of the plots for seed production were tallest in the 22-kilogram-a-hectare rate of seeding and shortest in the 67-kilogram rate. The plants in the 34-kilogram-a-hectare rate of seeding were significantly taller than those in the 67-kilogram rate, and those in the 56-kilogram rate were significantly taller than those in the 34-, 45-, and 67-kilogram rates. When the plants were 175 days of age, the results showed that height progressively increased as the rate of seeding was decreased; the differences from each other of the various rates of seeding were significant.

Quality of the fiber in relation to the rate of seeding. The fibers from the different plots harvested at the age of 127 and 134 days were more or less the same in softness, brightness, and luster. They were superior to those of the 141-, 148-, and 155-day-old plants. As stated previously, the rates of seeding affected the length of the fibers.

Table 4 shows that the tensile strength of the fibers was not affected significantly by the rate of seeding, although it became less as the plants grew older. Table 4 further shows that the yield of the 134-day-old harvest was greater than that of the 127-day-old harvest and that the tensile strength at these ages was higher than at any other age. The 134-day-old harvest gave the strongest fibers and the 155-day-old harvest, the weakest.

SUMMARY AND RECOMMENDATIONS

1. Based on the assumption that all seeds would germinate, the rates of seeding for both fiber and seed production were 275, 425, 563, 700, and 838 grams of seeds (*viridis* variety) to each 50-square-meter plot. These rates are equivalent to 22, 34, 45, 56, and 67 kilograms to a hectare, respectively.

2. The yield and height of the plants in both fiber and seed production plots tended to increase as the seeding rate was decreased. The 22-kilogram rate of seeding, distanced at 8 x 2 inches, gave the highest yield of dry fiber to a plant (8.65 grams). The 34-kilogram rate was second with 7.14 grams; the 67-kilogram rate, third, with 5.70 grams; the 56-kilogram rate, fourth, with 5.49 grams; and the 45-kilogram rate, last, with 4.86 grams.

In the production of seeds the 22-kilogram rate ranked first with 7.92 grams of seeds; the 34-kilogram rate, second, with 7.72 grams; the 45-kilogram rate, third, with 6.65 grams; the 56-kilogram rate, fourth, with 5.83 grams; and the 67-kilogram rate, last, with 4.23 grams.

3. The tensile strengths of the different rates of seeding did not differ significantly. The 134-day-old harvest (blooming stage) gave the strongest fiber (24.9 kilometers) and the 155-day-old harvest, the weakest (16.4 kilometers). The fibers obtained from the 127-and 134-day-old harvests were superior in quality to those of the later harvests.

4. The 34-kilogram rate of seeding to a hectare can be tried for commercial seed production. For fiber production, a further study of the 34- and 67-kilogram rates a hectare should be conducted. Harvesting for fiber should be done during the blooming stage.

LITERATURE CITED

Eotkin, C. W., C. B. Shires, and E. C. Smith. 1943. Fiber of native plants of New Mexico. New Mexico Agric. Exper. Sta. Bull. 300: 1–38. *Fig. 1–12.*

CRANE, J. C., AND JULIAN B. ACUÑA. 1945. Effect of plant spacing and time of planting on seed yield of kenaf, *Hibiscus cannabinus* L. Jour. Amer. Soc. Agron. **37**: 969–977.

CRANE, J. C., JULIAN B. ACUÑA, AND RAUL E. ALONSO. 1946. Effect of plant spacing and time of planting on fiber yield of kenaf, *Hibiscus cannabinus* L. Jour. Amer. Soc. Agron. **38**: 45–59.

DAVID, PEDRO A. 1948. Kenaf (*Hibiscus cannabinus* Linn.) culture in the College of Agriculture at Los Baños. Philippine Agriculturist **32**: 21–30.

ERGLE, D. R., B. B. ROBINSON, AND J. M. DEMPSEY. 1945. Malvaceous bast fiber studies. Jour. Amer. Soc. Agron. **37**: 113–126.

WATKINS, JAMES M. 1946. Growth and fiber production of kenaf, *Hibiscus cannabinus* L., as affected by plant spacing in El Salvador. Jour. Amer. Soc. Agron. **38**: 978–982.

WATKINS, JAMES M., AND ENRIQUE ALLWOOD. 1948. Retting of kenaf, *Hibiscus cannabinus* L. Jour. Amer. Soc. Agron. **40**: 997–1004.

TABLE 1

Yield of dry fiber in grams to a plant as influenced by rate of seeding and age at harvest of plants planted at 8 × 2 inches

AGE OF PLANT AT HARVEST	RATE OF SEEDING TO A HECTARE IN KILOGRAMS					TOTAL	MEAN
	22	34	45	56	67		
days							
127	8.63	5.97	3.26	4.43	3.96	26.25	5.25
134	8.35	6.22	3.94	5.74	5.45	29.70	5.94
141	8.30	6.67	5.39	5.19	6.13	31.68	6.33
148	8.93	7.61	6.12	6.26	6.55	35.47	7.09
155	9.04	9.22	5.57	5.81	6.42	36.06	7.21
Total	43.25	35.69	24.28	27.43	28.51	159.16	
Mean	8.65	7.14	4.86	5.49	5.70		

Analysis of variance

SOURCE OF VARIATION	DF	SUM OF SQUARES	VARIANCE	COMPUTED F-VALUE	TABULAR F-VALUE	
					5%	1%
Age of plant at harvest	4	13.36	3.34	8.45	3.01	4.77
Rate of seeding	4	46.56	11.63	29.46	3.01	4.77
Error	16	6.33	0.395			
Total	24	66.25				

L.S.M.D. = 0.842

TABLE 2

Yield of seeds in grams to a plant as influenced by different rates of seeding of plants planted at 20 × 2 inches

RATE OF SEEDING TO A HECTARE	REPLICATIONS			TOTAL	MEAN
	1	2	3		
kg.					
22 [a]	9.82	7.02	6.93	23.77	7.92
34 [a]	6.98	7.02	9.15	23.15	7.72
45	9.06	5.88	5.00	19.94	6.65
56	6.62	5.95	4.91	17.48	5.83
67	4.22	5.74	2.74	12.70	4.23
Total	36.70	31.61	28.73	97.04	
Mean	7.34	6.32	5.75		

Analysis of variance

SOURCE OF VARIATION	DF	SUM OF SQUARES	VARIANCE	COMPUTED F-VALUE	TABULAR F-VALUE	
					5%	1%
Rate of seeding	4	27.342	6.836	3.20	3.84	7.01
Replication	2	6.515	3.256	1.53	4.46	8.65
Error	8	17.077	2.135			
Total	14	50.934				

[a] Attacked by disease.

TABLE 3

Effect of different seeding rates on average height of kenaf plants

For Fiber

RATE OF SEEDING TO A HECTARE	HEIGHT OF PLANT	
	92 days	134 days
kg.	*cm.*	*cm.*
22	224.2 ∓ 2.5	259.6 ∓ 4.4
34 [a]	202.1 ∓ 1.3	230.4 ∓ 2.0
45 [a]	197.5 ∓ 2.7	204.4 ∓ 1.6
56	193.6 ∓ 3.1	238.6 ∓ 2.1
67	185.1 ∓ 1.7	229.5 ∓ 2.6

For Seed

RATE OF SEEDING TO A HECTARE	HEIGHT OF PLANT	
	91 days	175 days
kg.	*cm.*	*cm.*
22 [a]	190.0 ∓ 2.6	279.6 ∓ 1.5
34 [a]	166.6 ∓ 3.5	257.5 ∓ 1.3
45	173.3 ∓ 1.5	251.7 ∓ 1.4
56	180.7 ∓ 1.9	236.6 ∓ 1.7
67	159.8 ∓ 2.1	220.6 ∓ 1.3

[a] Attacked by disease.

TABLE 4

Tensile strength in kilometers of fibers taken from the different rates of seeding as influenced by age of plants at harvest

AGE OF PLANT AT HARVEST	RATE OF SEEDING TO A HECTARE IN KILOGRAMS					TOTAL	MEAN
	22	34	45	56	67		
days							
127	25.8	20.0	29.6	23.8	20.2	119.4	23.9
134	20.0	26.4	24.0	17.4	36.6	124.4	24.9
141	14.8	21.2	16.2	18.4	20.6	91.2	18.2
148	15.8	19.6	14.0	16.4	18.2	84.0	16.8
155	17.8	15.2	17.8	15.4	15.8	82.0	16.4
Total	94.2	102.4	101.6	91.4	111.4	501.0	
Mean	18.8	20.5	20.3	18.3	22.3		

Analysis of variance

SOURCE OF VARIATION	DF	SUM OF SQUARES	VARIANCE	COMPUTED F-VALUE	TABULAR F-VALUE	
					5%	1%
Rate of seeding	4	49.18	12.30	0.67	3.01	4.77
Age of plant at harvest .	4	325.80	81.45	4.46	3.01	4.77
Error	16	291.92	18.25			
Total	24	666.90				

L.S.M.D. = 0.5724

THE GROWTH AND HABITS OF LAMBS [1]

RUFINO M. SOJETADO

A study to determine (*a*) the growth of lambs at different ages based on body weight, height at withers, heart girth, width between points of shoulders, depth of chest, width between points of hips, and body length; (*b*) the frequency of mating, urination, and defecation and the frequency and duration of sucking and rumination; (*c*) the age at which lambs nibble on concentrate and forage; (*d*) the natural weaning age; (*e*) the time when rams begin to mount and mate; (*f*) the time ewes first accept the male in mating; (*g*) the age when ewes give birth for the first time; and (*h*) the consumption of concentrate was conducted in the Department of Animal Husbandry from April 23, 1949, to March 11, 1950.

PROCEDURE

Management of animals. Twenty-five grade Shropshire lambs composed of 13 males and 12 females were used in this study. These animals were part of the sheep flock of the Department of Animal Husbandry. Newly born lambs were kept in the sheep barn from three to four days, after which time they were considered strong enough to follow their dams to the pastures. During the day, the lambs were with the rest of the flock. In the morning, the animals were grazed in the pasture at about 7:00 o'clock and returned to the barn at about 11:00 o'clock. At about 1:00 o'clock in the afternoon they were driven again to the pasture, and at about 3:00 o'clock they were returned to the barn where they stayed until the next morning. On rainy days, however, when it was impossible to pasture the flock, all the animals were fed forage in the barn. Water was available to them at all times.

Weighing and measuring of animals. The weights and measurements were taken at birth and weekly thereafter for 51 weeks. The lambs were made to stand squarely on their legs on a concrete floor before measurements with a wooden caliper were taken. The average of three trials was computed as the measurement for one week.

The height was determined by measuring the perpendicular distance from the floor to the top of the withers, and the heart girth, by measuring an abacá string three-sixteenth of an inch in diameter placed around the chest of the animal just behind the shoulders. The widest portion across the chest, that is, between the points of

[1] Central Experiment Station Contribution No. 1655. Thesis presented for graduation with the degree of Bachelor of Science in Agriculture from the College of Agriculture, University of the Philippines, October, 1950. Prepared in the Department of Animal Husbandry under the direction of Professor Valente Villegas.

the shoulders, was measured to obtain the width of the breast. The deepest portion of the chest between the back and the lower portion was measured to obtain the depth of chest. The width of the loin between the points of the hips was measured. The length of the body was determined by measuring the distance between the pin bone and the point of the left shoulder.

Observation of the animals. Eight 24-hour observations were made on the frequency of mating, urination, and defecation and the frequency and duration of sucking and rumination of five lambs and their dams ranging in age from birth to 150 days. These observations were done once a month in a barn from 6:00 o'clock in the afternoon to 6:00 o'clock the following afternoon. Two kerosene lamps lighted the barn at night. The dams were supplied with forage, concentrate, and water during the observations.

Frequency of mating was determined by noting down the times lambs mated successfully. The first mounting and the first mating of rams were observed with the cooperation of the herdsman who took care of the herd most of the time during the day. Observations were not made of the mounting of the ewes. The frequency of urination and defecation was determined by noting the number of times the animals urinated and defecated during the day and during the night. Attempts of the animals to suck though not allowed by their dams were also included in determining the frequency of sucking.

The first time the new-born lambs of both sexes nibbled forage and concentrate was noted. From birth to four days of age the young were kept in the sheep barn and were supplied forage and concentrate from 4:00 to 5:00 o'clock in the afternoon. After four days, when the young were already strong enough to follow their dams to the pastures, they were observed every morning from 7:30 to 8:00 o'clock. The second time that each lamb was noted to nibble forage or concentrate was considered the nibbling age.

Daily consumption of concentrate was observed by placing five lambs on a wooden platform divided into five compartments, each 48 cm. wide and 102 cm. long. The five lambs of different ages were allowed to start eating concentrate composed of equal parts of fine rice bran, ground corn, and ground copra meal from 6:00 o'clock in the afternoon to 6:00 o'clock the following morning. Every morning, the boxes filled with concentrate were weighed to determine the individual consumption of each lamb.

RESULTS

Weights and measurements at birth. The birth weight of the male lambs ranged from 1.8 to 2.8 kg., the mean being 2.27 $\mp$ 0.13 kg.; that of the female lambs ranged from 2.0 to 2.5 kg., or a mean of 2.31 $\mp$ 0.06 kg.

The height at birth of male lambs ranged from 30.0 to 33.5 cm., the mean being 32.56 $\mp$ 1.08 cm.; that of the female lambs ranged from 30.5 to 37.0 cm., or a mean of 32.72 $\mp$ 0.58 cm.

The heart girth at birth of male lambs ranged from 30.5 to 34.0 cm., the mean being 32.60 ∓ 0.51 cm.; that of the female lambs ranged from 30.5 cm. to 35.0 cm., or a mean of 32.7 ∓ 0.40 cm.

The width of breast at birth of male lambs ranged from 6.5 to 8.5 cm., the mean being 7.87 ∓ 0.22 cm.; that of the female lambs ranged from 6.0 to 8.5 cm., or a mean of 7.0 ∓ 0.24 cm.

The depth of chest at birth of male lambs ranged from 11.5 to 12.5 cm., the mean being 12.25 ∓ 0.70 cm.; that of the female lambs ranged from 10.5 to 13.5 cm., or a mean of 12.20 ∓ 0.22 cm.

The width of loin at birth of male lambs ranged from 5.0 to 6.5 cm., the mean being 5.87 cm.; that of the female lambs ranged from 5.0 to 6.5 cm., or a mean of 5.64 ∓ 0.13 cm.

The body length at birth of male lambs ranged from 22.5 to 28.0 cm., the mean being 26.62 ∓ 0.67 cm.; that of the female lambs ranged from 25.0 to 29.0 cm., or a mean of 26.0 ∓ 0.61 cm.

Weight. The greatest increase in weight was during the second month when the average increase in weight of five males was 3.54 kg. and that of eight females was 4.26 kg. From the age of two months up to eleven or twelve months, the increase was not steady. At five to six months of age, eight males had an average weight of 20.63 kg., and seven females, 16.15 kg. At eleven to twelve months of age, six males had an average weight of 28.88 kg., and two females, 27.66 kg. When the lambs were from five to six months up to eleven or twelve months old, the increase in weight of the females amounted to 13.62 kg., and that of the males, 14.40 kg.

Height. The highest increase in height of six males and nine females was registered at one to two months of age, the males having an average increase of 8.07 cm. and the females, 9.69 cm. From one to two months of age up to eleven or twelve months, both sexes made more or less steady increase in height. The total average increase in height of both sexes for the first three months was greater than the total average increase in height from the third to the twelfth month.

At five to six months of age, the males had an average height of 54.87 cm., or 3.17 cm. more than the females. As they grew to the age of eleven or twelve months, the males made a difference of 3.21 cm. over the females. From birth up to the age of maturity, except at the age of one to two months, the males were always taller than the females.

Heart girth. At one to two months of age, six males and nine females made the greatest increase in heart girth. The males made an increase of 12.73 cm., and the females, 10.89 cm. From two to twelve months of age of the lambs, the increase in both sexes was not steady. The females had a greater heart girth than the males at birth, but thereafter up to twelve months of age, the males were always larger than the females.

When the lambs were five to six months old, the heart girth of the males was 3.8 cm. bigger than that of the females. The aver-

age heart girth of eight male lambs at birth was 32.62 cm.; at the age of five to six months, the males had a heart girth of 68.06 cm., which was 208 per cent of the heart girth at birth. Likewise, the average heart girth of eleven female lambs at birth was 33.04 cm.; at the age of five to six months, the females had a heart girth of 64.14 cm., or 190.0 per cent of the heart girth at birth. At the age of eleven to twelve months, the males had a heart girth 5.4 cm. bigger than that of the females. At this age the heart girth of the males increased to 2.48 times the heart girth at birth, and that of the females, to 2.27 times.

Width of breast. At one to two months of age, nine males and eleven females made the greatest increase in width of breast. From two to twelve months of age of the lambs, the increase was irregular.

At the age of five to six months, nine males had wider breasts than seven females, the difference being 1.0 cm. At the age of eleven to twelve months of the lambs, however, the difference was 0.87 cm. At birth eight males had an average width of breast of 7.87 cm., and from eleven to twelve months, 18.38 cm. Likewise, the average width of breast of eleven females at birth was 7.36 cm., and at eleven to twelve months of age, 17.50 cm. From birth up to maturity the males always had wider breasts than the females.

Depth of chest. The depth of chest of male and female lambs continued to increase up to the eleventh or twelfth month. The greatest increase in depth of chest of six males was 6.5 cm., which occurred when they were one to two months old. At the same age, nine females also made the greatest increase in depth of chest of 4.19 cm. The differences in depth of chest at the ages of five to six months and at eleven to twelve months were in favor of the males.

Width of loin. The greatest increase in the width of loin was registered on the first to the second month of age; the average increase of six males was 3.21 cm. At this same age the females also registered the greatest increase, the average increase being 2.84 cm. for nine animals. Eight male lambs at birth had wider loins than eleven females. This was also true at the age of five to six months. However, when the lambs were eleven to twelve months old, the loin of the females became 1.45 cm. bigger than that of the males. This parallels Galeon's findings (1948) that the female goats, at the age of fifteen months, have wider loins than the males.

Length of body. The body length of the male lambs at birth was slightly longer than that of the females. The greatest increase in body length was registered on the first and second months, the average increase for six males being 11.61 cm. At this same age the females also registered the greatest increase, an average of 8.55 cm. for nine animals. The body length of rams at the age of five to six months was greater than that of the ewes by 2.86 cm. Similarly, at the age of eleven to twelve months, the males had a body length longer by 2.37 cm. At one to two months of age, the six

males and nine females made the greatest increase in body length. The males made an increase of 3.21 cm., and the females, 2.84 cm. From the second up to the twelfth month the increase was not steady.

Urination. The average frequency of urination of two lambs at birth was 1.50 times during the night and 2.00 times during the daytime. The total frequency of urination for 24 hours was 3.5 times. The greatest frequency of urination for four animals during the night, an average of 5.25 times, was noted at the age of 31 to 45 days. During the day, the highest frequency of urination in one animal was made at 106 to 150 days of age. The highest average frequency of urination (8.5 times) of four animals during any 24-hour observation was noted when they were 31 to 45 days of age.

Defecation. Two lambs at birth defecated two times during the day only. The highest average frequency at night was 3.0 times, registered when the lambs were 121 to 135 days of age; during the day, the highest average frequency made by three animals from 61 to 75 days of age was 3.66 times. The highest average frequency (6.32 times) in 24 hours was made at 61 to 75 days of age of the lambs.

Sucking. Two lambs at birth sucked 33.0 times during the night and 45.0 times during the day, making a total average of 78.0 times in 24 hours. The animals continued to suck up to the age of 136 to 150 days. The highest frequency of sucking in 24 hours was made at birth.

Lambs at birth sucked at an average duration of 58.7 seconds during the day. The average duration of sucking at night was 60.0 seconds. The highest average duration of sucking was registered from one to fifteen days of age of the lambs. It was 80.36 seconds during the day and 66.73 seconds during the night, the average in 24 hours being 77.32 seconds.

When the lambs were from 106 days to 120 days of age, the dams refused to be sucked any longer. They usually made a long rest two times at night, one at 11:00 o'clock and the other at 1:00 o'clock, the duration of each rest being one hour. They also rested for an hour two times during the day, the first at 12:00 o'clock and the second at 1:00 o'clock. The tail of the young wiggled while sucking. The dams often called their young when they were ready to feed.

Rumination. Two lambs observed at birth did not ruminate. The least frequency of rumination of an average of 2.0 times at daytime and 4.0 times during the night, or an average frequency of 6.0 times in 24 hours, was at the age of 15 days of the lambs. The highest frequency of rumination registered during the night was 97.0 times, made by three animals at the age of 121 to 135 days at an average duration of 71.0 seconds. During the day it was noted that animals 136 to 150 days of age had an average duration of rumination of 85.50 seconds. The highest frequency of rumination in 24

hours was registered by an animal between 136 and 150 days of age.

The least average duration of rumination at night was 65.45 seconds at a frequency of 63.0 times, registered at the age of 106 to 120 days of the lambs. The least average duration of rumination (29.87 seconds) during the daytime was made when the lambs were 31 to 45 days old, at a frequency of 41.75 times. The greatest average duration in 24 hours was made at the age of from 61 to 75 days of the lambs. It was 147.68 seconds, at a frequency of 84.0 times. The lambs usually ruminated when they were lying down. There were, however, a few animals that ruminated while standing. Lambs started to ruminate at the age of three days.

Nibbling. The nibbling age of lambs with regard to forage ranged from five to eight days, or a mean of 6.68 $\mp$ 0.20 days. The nibbling age for concentrate ranged from 7 to 25 days, or a mean of 16.2 $\mp$ 1.04 days. The lambs nibbled forage earlier than they did concentrate.

Weaning. The weaning age ranged from 84 to 149 days, or a mean of 114.1 $\mp$ 0.56 days. Lamb No. C-38 was weaned at the age of 84.0 days because the dam became dry early. The lambs separated from their dams as soon as they were stopped from sucking. There were instances, however, when the lambs insisted on sucking.

Mounting and mating. The male animals first mounted without mating when they were 15.0 to 70.0 days of age, or at a mean age of 30.8 $\mp$ 7.7 days. The rams first mated at the age of 92.0 to 201.0 days, or at a mean age of 140.7 $\mp$ 14.3 days.

Consumption of concentrate. Lambs at birth were observed not to eat concentrate. Four lambs not more than 30 days old consumed 25.57 grams each within 12 hours at night. At night, those aged 61 to 90 days consumed 121.25 grams a head; when the lambs were 91 to 120 days old, consumption abruptly increased to an average of 303.0 grams each. The abrupt increase was due to the fact that most of the lambs observed were already weaned by that time. The highest consumption of concentrate of 607.92 grams a head was made at the age of 181 to 210 days of the lambs. Since then, the consumption of concentrate became more or less uniform.

Mating and lambing of ewes. The age of first mating ranged from 186 days to 256 days, or an average of 215.7 days. Three of the females were observed for their first lambing. Lamb C-31 lambed at the age of 341 days; C-33, at the age of 403 days; and C-40 lambed at 340 days, making an average of 371.6 days. C-31 had a gestation period of 145 days; C-33, 147 days; and C-40, 146 days, the average being 146 days.

Wool. The amount of unscoured wool shorn when the lambs were one year of age ranged from 395 grams to 1,500 grams, the mean being 682.14 $\mp$ 197 grams.

SUMMARY

1. There were only slight differences in weight and measurements between the two sexes of sheep at birth. The male and female lambs made the greatest increase in weight, height, heart girth, width of shoulder, depth of chest, width of loin, and body length at one to two months of age.

2. From birth to 150 days of age, the animals, on the average, urinated 5.35 times and befecated 3.72 times.

3. Two lambs sucked 78.0 times in 24 hours after birth, but the frequency decreased gradually to 20.0 times when the lambs were one and a half months of age and to only 7.4 times when they were three to three and a half months.

4. When the lambs were one to fifteen days old, the average frequency of rumination in 24 hours was 6.0 times, each rumination lasting for 95.48 seconds; when they were four and a half to five months of age, the frequency was 139.0 times for 80.60 seconds each time. Lambs started to ruminate at an average age of three days.

5. Nineteen lambs of both sexes started to nibble forage at 6.68 $\mp$ 0.20 days of age and concentrate at 16.2 $\mp$ 1.04 days.

6. The animals were weaned at the age of 114.1 $\mp$ 0.56 days. They started to mount at 30.18 $\mp$ 7.7 days of age. The rams mated at the age of 140.7 $\mp$ 14.3 days and the ewes, at the age of 215.7 days.

7. From the age of one to 30 days, the sheep each consumed an average of 25.5 grams of concentrate daily; at the age of 121 to 150 days, 439.90 grams; and at the age of 211 to 240 days, 594.28 grams.

8. The mean weight of unscoured wool shorn when the lambs were at the age of one year was 682.14 $\mp$ 197 grams.

TWO STANDARD RATIONS FOR GROWING AND FATTENING PIGS [1]

TEODORO DE JAUREGUI

The series of standard rations developed in the College of Agriculture for growing and fattening pigs has not only proved efficient but also practical, in the sense that the ingredients used are all easily obtainable locally. Using these rations, Penuliar (1940) found that pigs gained an average of 0.21 kilograms daily and required an average of 4.58 kilograms of feed for one kilogram gain in weight. In another experiment Binoya (1941) found that pigs given the College rations gained 0.22 kilogram daily and required 6.48 kilograms of feed for every kilogram they gained in weight.

A similar series of rations whose ingredients are like those of the College standard rations, but to which is added soybean-oil meal, has been developed in the Bureau of Animal Industry. These rations have been found by Burgos (1949) to produce good results. Morrison (1948) pointed out that particularly good results were secured when pigs were fed soybean-oil meal in combination with protein supplements of animal origin.

The present study to compare the efficiency of the College standard rations and those used by the Bureau of Animal Industry for growing and fattening market pigs was conducted in the Department of Animal Husbandry from June 1, 1950, to January 31, 1951, a period of 240 days.

MATERIALS AND METHODS

Eighteen Berkjala weanlings, nine barrows and nine female shotes, ranging from four to six months in age and from 7.6 kilograms to 16.4 kilograms in weight were divided according to age and weight into three lots of three barrows and three female shotes each. The average weight of the pigs in lot 1 was 12.28 kilograms, that of lot 2 was 12.17 kilograms, and that of lot 3, 12.17 kilograms.

The feeding test lasted 240 days and was divided into periods of 60 days each. As shown on the next page, the rations used in lot I were those of the College; in lot 3, those of the Bureau of Animal Industry; and in lot 2, a 50-50 combination of the rations of lot 1 and lot 3. To every 100 kilograms of concentrate feed, one kilogram of salt was added.

[1] Central Experiment Station Contribution No. 1656. Thesis presented for graduation with the degree of Bachelor of Science in Agriculture from the College of Agriculture, April, 1951. Prepared in the Department of Animal Husbandry under the direction of Dr. Mariano Mondoñedo.

GROWTH PERIOD

Constituents, all parts by weight

First 60-day period	*Lot 1*	*Lot 2*	*Lot 3*
Ground corn	15	17.5	20
Fine rice bran	60	50.0	40
Copra meal	18	19.0	20
Fish meal	7	6.0	5
Soybean-oil meal	0	7.5	15
Total	100	100.0	100
Second 60-day period			
Ground corn	20	20	20
Fine rice bran	60	50	40
Copra meal	16	18	20
Fish meal	4	4.5	5
Soybean-oil meal	0	7.5	15
Total	100	100.0	100

FATTENING PERIOD

Third 60-day period			
Ground corn	25	29.25	33.5
Fine rice bran	60	46.75	33.5
Copra meal	13	14.75	16.5
Fish meal	2	3.00	4.0
Soybean-oil meal	0	6.25	12.5
Total	100	100.00	100.0
Fourth 60-day period			
Ground corn	30	31.75	33.5
Fine rice bran	60	46.75	33.5
Copra meal	9	12.75	16.5
Fish meal	1	2.50	4.0
Soybean-oil meal	0	6.25	12.5
Total	100	100.00	100.0

The composition of the first three ingredients used, as taken from Santiago (1926), and that of the fourth, as analyzed in the Department of Agricultural Chemistry of this College, are given below:

INGREDIENT	MOISTURE	ASH	PROTEIN	TOTAL CARBOHYDRATES	FAT
	per cent	*per cent*	*per cent*	*per cent*	*per cent*
Ground corn	13.88	2.61	8.90	70.14	4.41
Fine rice bran	13.81	15.48	11.56	50.74	8.41
Copra meal	12.83	7.26	17.50	56.64	5.77
Soybean-oil meal	14.47	5.73	42.16	21.83	10.23

The fish meal used in the study was guaranteed by the manufacturer to contain 70.69 per cent protein.

The pigs in the three lots were fed morning and afternoon with as much feed as they could readily consume. In addition to the concentrates, the pigs were given soilage of camote vines at noon at the rate of one per cent of their live weight during the first three feeding

periods. During the last period, however, the pigs were given concentrates only. The pigs were fed in their respective pens and driven out afterwards into an enclosed yard 26 by 22 meters in area. The yard was bare of vegetation except for a large tree which provided ample shade for the pigs during hot weather. The pigs were provided with drinking water at all times and were bathed regularly to keep them cool, especially before weighing. They were kept in their pens after their afternoon feeding and during bad weather.

The pigs were weighed once a week and the weekly feed consumption for each lot was recorded. The initial and final weights of the pigs were obtained by taking the average of three weighings.

RESULTS AND DISCUSSION

In the present study, the bases for determining the economy and efficiency of each of the three rations were the following: (1) gain in weight of the pigs, (2) amount of feed needed by the pigs to make one kilogram gain in weight, and (3) cost of the feed to make one kilogram gain in weight. The results obtained from lots 2 and 3 were compared with those of lot 1, the control lot.

First 60-day period. The results show that lot 3 gained most in weight during the first two months of the experiment, the average daily gain being 0.272 kilogram; lot 2 was second with an average daily gain of 0.252 kilogram; and lot 1, last, with an average daily gain of 0.205 kilogram. In the amount of feed consumed for a kilogram gain in weight, lot 3 consumed the least (3.14 kilograms), lot 2 was next (3.28 kilograms), and lot 1 consumed the most (3.93 kilograms). From the point of view of feed cost for every kilogram gain in weight, however, lot 2 proved to be the most economical (₱0.525); lot 1 was second (₱0.554); and lot 3 was the least economical (₱0.560).

For some unknown reason, pig No. 612 in lot 1 failed to make the proper gains in weight at the outset of the experiment. It was only around the middle of November, that is, about four months after the start of the experiment, that the pig started to make normal gains. The rest of the animals in this lot gave a good account of themselves and if it were not for the pig which made slow gains, the lot would have given better results as a whole.

Second 60-day period. At the beginning of the second 60-day period, pig No. 563 in lot 2 died from roundworm (*Ascaris suis*) infestation in spite of the treatment given.

The pigs in lot 2 gained the most in weight, with an average of 41.74 kilograms after four months of feeding, or an average daily gain of 0.348 kilogram for each pig in the lot; lot 3 was second, each pig having had an average total gain of 39.18 kilograms, or an average of 0.327 kilogram daily gain; lot 1 was last with an average total gain of 32.90 kilograms for each pig, or an average daily gain of 0.274 kilogram. Lot 3 consumed the least feed (3.48 kilograms) for every kilogram gain in weight after four months of feeding. Lot 2 was

second with 3.50 kilograms, and lot 1, with 4.18 kilograms, consumed the most. The cost of feed needed for a kilogram gain in weight during the first four months of feeding was least in lot 2 (₱0.578), higher in lot 1 (₱0.606), and highest in lot 3 (₱0.651).

Third 60-day period. At the end of six months of feeding, lot 2 maintained first place with an average total gain of 65.18 kilograms in weight for each pig, or 0.362 kilogram daily gain; lot 3 was second with an average total gain of 63.46 kilograms for each pig, or an average daily gain of 0.353 kilogram; and lot 1 was last with an average total gain of 51.99 kilograms, or an average daily gain of 0.288 kilogram. In the amount of feed consumed for every kilogram of gain in weight, lot 2 required the least with an average of 4.07 kilograms; lot 3 was second with 4.17 kilograms; and lot 1, last, with 4.65 kilograms. The differences between them were insignificant. With respect to the cost of feed consumed to produce one kilogram gain in weight, lot 2, as in the preceding period, was still the most economical (₱0.720) at the close of the third 60-day period; lot 1 with a cost of ₱0.818 was second; and lot 3 with a cost of ₱0.838 was the most expensive.

It is interesting to note that lot 2 assumed first place by all the three criteria in the third 60-day feeding period. While lot 3 produced the highest rate of gain and required the least feed at the end of the period, lot 1 gave better results in feed cost for every kilogram gain in weight.

Fourth 60-day period. At the conclusion of eight months of feeding, the pigs in lot 2 had gained most in weight, the total average gain being 86.62 kilograms for each pig, or an average daily gain of 0.361 kilogram; lot 3 was next with an average of 84.93 kilograms for each pig, or an average daily gain of 0.354 kilogram; lot 1 with an average total gain of 69.97 kilograms for each pig, or an average daily gain of 0.291 kilogram, was far behind. In feed consumption, lot 3 required 4.65 kilograms, lot 2, 4.97 kilograms, and lot 1, 5.38 kilograms. In the cost of feed to produce a kilogram of gain in weight, lot 2 was the least expensive (₱0.889); lot 1 was second (₱0.929); and lot 3 was the most expensive (₱0.999). The average increase in weight of all the pigs in the three lots was 80.51 kilograms after eight months of feeding. With this increase in weight, it would have cost ₱61.62 in feed to raise the pig that increased that much in lot 2, ₱74.84 in lot 1, and ₱80.43 in lot 3.

Judged by the results obtained during the different periods of the experiment, the pigs in lot 1 consistently made the least gain in weight throughout the experiment and consumed the most feed for every unit gain in weight, but the cost of feed they consumed for every unit of gain in weight was the second to the lowest among the three lots. The pigs in lot 2 gained most in weight beginning with the second 60-day period until the end of the experiment. In the second 60-day period they consumed the most feed; in the third 60-day period, however, they consumed the least amount; and in the

fourth 60-day period, they consumed the second lowest amount for every unit gain in weight. The cost of the feed consumed by the pigs was consistently the lowest among the three lots. The pigs in lot 3, in general, were second to the highest in gain in weight and consumed the least amount of food for every unit gain in weight, but in cost of feed consumed they were consistently the highest among the three lots.

Based on the cost of producing a unit gain in weight, lot 1 is more desirable than lot 3.

SUMMARY

1. The College standard rations (lot 1), the Bureau of Animal Industry rations (lot 3), and a 50-50 combination of the two rations (lot 2) for growing and fattening pigs for the market were tested for their relative efficiency. After four months of feeding, up to the end of the experiment, the pigs in lot 2 consistently gained more than those in lots 1 and 3, those in lot 1 consistently gaining the least.

2. In the amount of feed consumed to produce a given unit of gain in weight, lot 3 required the least; lot 2, the second lowest; and lot 1, consistently the most.

3. In the cost of feed to produce a given unit of gain in weight, lot 2 was consistently the least expensive at any period in the course of the experiment; lot 1 was second; and lot 3, the most expensive.

4. The results of the experiment show that the 50-50 combination of the College rations and the Bureau of Animal Industry rations was the best. Although the rations of the Bureau enabled the pigs to gain weight faster, the College standard rations proved to be more economical for every unit gain in weight of the pigs.

LITERATURE CITED

BINOYA, C. S. 1941. A comparative study on the value of sugar and corn as basal feeds for growing and fattening pigs. Philippine Agriculturist **29**: 766–771.

BURGOS, C. X. 1949. Rations for different animals from feeds locally available. Philippine Dept. Agric. Bull. **25**: 1–21.

MORRISON, F. B. 1948. Feeds and feeding. 21st ed., vi + 1207 p. New York: The Morrison Publishing Company.

PENULIAR, S. P. 1940. A comparative study of cassava refuse meal and rice bran as feeds for growing and fattening pigs. Philippine Agriculturist **29**: 611–615.

SANTIAGO, M. S. 1926. Copra meal vs. dried shrimps as supplements to a basal ration consisting of corn and rice bran for growing barrows. Philippine Agriculturist **15**: 205–217.

THE SHRINKAGE OF CONCENTRATES IN STORAGE [1]

VALENTE VILLEGAS

Certain feeds shrink in storage, resulting in considerable loss. This loss may be attributed to various causes, the chief of which are evaporation of water and damage by weevils. In order to know the amount of loss resulting from these causes, a study was made in the Department of Animal Husbandry from June 4, 1947, to March 2, 1950.

PROCEDURE OF THE STUDY

The feeds studied were the following:

1. Fine rice bran obtained from a "cono" rice mill in Cabuyao, Laguna.
2. Coarse rice bran from a local "kiskis" mill.
3. Shelled Laguna Yellow Flint corn from the Department of Agronomy of the College of Agriculture.
4. Rough rice—Inintiw variety in the first trial and Magasawang Kinanda in the second.
5. Copra meal from the San Pablo Coconut Oil Mill, San Pablo City, Laguna.
6. Soybeans from the Department of Agronomy—Headgreen variety in the first trial and a mixture of varieties in the second.
7. American fish meal from the Philippine Relief and Trade Rehabilitation Administration (PRATRA).
8. Prawns caught in Laguna de Bay.

Ten-kilogram samples of fine rice bran, coarse rice bran, shelled corn, and rough rice were used. Of copra meal, 10.12 kilograms were used in the first trial and 10.4 kilograms in the second. Of soybeans, 9.85 kilograms were used for the first experiment and 9.2 kilograms for the second. Of fish meal, 10.0 kilograms were used in the first test and 9.6 kilograms in the second. Five kilograms of prawns were used in only one test. Weighings were made at the end of each month.

The feed samples were placed on trays, 54 cm. long, 50 cm. wide, and 14 cm. deep, with wooden sides and galvanized iron bottoms. Each tray had a wire-screen cover which prevented losses due to rats and other animals but did not interfere with the normal evaporation of moisture and volatile substances during storage in the feed bodega of the Department of Animal Husbandry.

---

[1] Central Experiment Station Contribution No. 1657. Read before the Los Baños Biological Club on July 28, 1950.

RESULTS

The results of the tests are tabulated in tables 1 and 2.

Weevil infestation

Soybean, rough rice, and copra meal were free from weevils throughout the experiment. Corn in one tray was attacked by weevils *Calandra oryzae* Linn. on the first month; the rest of the trays had weevils *Tribolium castaneum* Herbst. on the second month, and coarse rice bran, on the third month. Two of the samples of fish meal were attacked by weevils on the second month; the rest were attacked on the third month.

SUMMARY

1. The percentages of losses of the feeds stored for six months, based on their initial weights, were as follows: fine rice bran, 36.69 per cent; shelled corn, 21.83 per cent; coarse rice bran, 20.23 per cent; prawns, 15.60 per cent; soybean, 6.38 per cent; rough rice, 5.43 per cent; and fish meal, 5.05 per cent. Copra meal increased in weight by as much as 2.54 per cent of the initial weight because of absorption of moisture.

2. In relation to the total shrinkage, fine rice bran lost 30.98 $\mp$ 4.54 per cent on the second month and 30.64 $\mp$ 5.30 per cent on the third month. In coarse rice bran the heaviest shrinkage, amounting to 41.34 $\mp$ 3.84 per cent, was on the third month. The loss in shelled corn was heavy on the fifth month, when it amounted to 33.68 $\mp$ 5.79 per cent. On the sixth month it was 28.78 $\mp$ 4.69 per cent. The shrinkage in rough rice was highest on the fifth and sixth months. Soybean registered its heaviest shrinkage on the third month, but increased in weight on the sixth month. The period of highest shrinkage in fish meal, amounting to 38.21 $\mp$ 10.86 per cent, was on the third month. The heaviest loss in prawns occurred on the sixth month when the shrinkage was 44.28 $\mp$ 9.30 per cent of the total loss.

3. Copra meal showed variable weights throughout the period of observation; it increased in weight four times because of absorption of moisture.

TABLE 1

Percentages of loss or gain each month from the initial weights of the feeds

MONTH	FINE RICE BRAN *per cent*	COARSE RICE BRAN *per cent*	SHELLED CORN *per cent*	COPRA MEAL *per cent*	ROUGH RICE *per cent*	SOYBEAN *per cent*	FISH MEAL *per cent*	PRAWNS *per cent*
First	0	0.544 ∓ 0.16	0.411 ∓ 0.97	—0.496 ∓ 0.76	1.253 ∓ 0.349	2.102 ∓ 4.29	0.218 ∓ 0.41	0
Second	10.950 ∓ 1.67	4.943 ∓ 0.69	0.830 ∓ 0.74	—0.399 ∓ 2.52	0.463 ∓ 0.41	0.595 ∓ 0.63	0.143 ∓ 0.23	0.8 ∓ 0.92
Third	11.460 ∓ 6.48	8.614 ∓ 2.68	5.078 ∓ 2.58	—1.488 ∓ 2.64	0.565 ∓ 0.43	1.677 ∓ 2.82	1.065 ∓ 0.74	4.8 ∓ 8.0
Fourth	6.424 ∓ 2.82	4.386 ∓ 2.92	4.240 ∓ 4.62	2.467 ∓ 3.03	0.292 ∓ 0.26	0.316 ∓ 0.23	0.499 ∓ 0.40	2.4 ∓ 0.8
Fifth	4.505 ∓ 2.27	1.377 ∓ 1.70	3.700 ∓ 5.83	—3.982 ∓ 12.16	1.305 ∓ 1.75	0.569 ∓ 0.36	0.817 ∓ 1.10	2.4 ∓ 1.78
Sixth	3.348 ∓ 1.04	0.362 ∓ 3.60	7.575 ∓ 4.43	1.355 ∓ 1.00	1.552 ∓ 4.370	1.125 ∓ 2.85	2.304 ∓ 5.12	6.0 ∓ 7.37
Total	36.69	20.23	21.83	—2.541	5.430	6.38	5.05	15.60

TABLE 2

Percentages of loss or gain each month in relation to total shrinkage

MONTH	FINE RICE BRAN *per cent*	COARSE RICE BRAN *per cent*	SHELLED CORN *per cent*	COPRA MEAL *per cent*	ROUGH RICE *per cent*	SOYBEAN *per cent*	FISH MEAL *per cent*	PRAWNS *per cent*
First	0	2.94 ∓ 1.22	1.47 ∓ 1.10	16.12 ∓ 9.59	9.75 ∓ 5.82	48.10 ∓ 9.69	4.13 ∓ 2.75	0
Second	30.98 ∓ 4.54	24.05 ∓ 1.35	2.37 ∓ 0.94	—52.25 ∓ 127.24	127.20 ∓ 68.84	38.16 ∓ 16.04	3.31 ∓ 1.52	8.09 ∓ 6.14
Third	30.64 ∓ 5.30	41.34 ∓ 3.84	18.12 ∓ 3.00	—14.69 ∓ 143.65	107.64 ∓ 52.46	70.45 ∓ 26.77	38.21 ∓ 10.86	13.33 ∓ 13.33
Fourth	18.04 ∓ 2.61	21.23 ∓ 4.70	15.55 ∓ 5.16	22.03 ∓ 165.01	115.43 ∓ 64.76	21.61 ∓ 9.64	12.05 ∓ 3.46	22.42 ∓ 5.24
Fifth	12.52 ∓ 2.16	7.14 ∓ 3.01	33.68 ∓ 5.79	46.12 ∓ 20.04	551.26 ∓ 394.33	32.75 ∓ 13.96	10.50 ∓ 4.65	25.12 ∓ 3.73
Sixth	9.20 ∓ 0.81	0.00 ∓ 5.41	28.78 ∓ 4.69	51.78 ∓ 96.35	811.18 ∓ 529.73	—110.97 ∓ 52.72	21.85 ∓ 9.73	44.28 ∓ 9.30

COLLEGE AND ALUMNI NOTES

Dr. Kurt Wenzel of the Foreign Trade Development Division of E. I. Du Pont De Nemours & Company, Inc., Wilmington, Delaware, U.S.A., accompanied by Dr. Barker H. Brown of the Chemicals & Dyestuffs Department of Macondray & Co., Inc., Manila, and Mr. Potenciano C. Reaño, '40, of the Chemicals Department also of Macondray & Co., Inc., came to the College on February 15, 1952, to inquire about the work on herbicides for the eradication of cogon and mosaicked abacá in the Department of Plant Pathology, the experiments of Dr. G. B. Viado on insecticides for tomato and eggplant in the Department of Entomology, and the chemical sprays for large animals in the Department of Animal Husbandry.

The first response to an appeal of the College for donation of old copies of *The Philippine Agriculturist* came from Mr. Gaudencio C. Zabella, '22, who sent a copy of Vol. 3, No. 2, 1914, and a copy of Volume 4, No. 1, 1915. In his letter Mr. Zabella stated, "These copies are indeed very valuable to me in my personal library. However, inasmuch as our Alma Mater needs them for her library, I consider it my moral obligation to give them to her."

Dr. Pablo N. Mabbun, '23, economist of the RFC, gave the students in Agricultural Economics 7, Rural Credit, a lecture when they visited the RFC on February 16, 1952. The class was headed by its instructor, Mr. Albino P. Varona, '29.

Mr. Engracio J. Basio, '31, former librarian of the College, has been appointed chief librarian of the College effective January, 1952.

Mr. José R. Mondoñedo, '49, instructor in agronomy who is on leave in the United States on Fulbright and I.I.E. fellowships, was recently awarded a master of science degree by the University of Maryland.

Dr. Y. C. James Yen, internationally known Chinese educator, was guest speaker at a special convocation on February 18, 1952. He was accompanied by Mrs. Yen and his secretary. After the convocation, the visitors were honored with a luncheon by the heads of the College departments.

Dr. Meredith B. Givens, director of research and statistics of the New York State Department of Labor and technical consultant to the Philippine government and to U. S. federal agencies in Manila, discussed statistical problems with members of the College staff.

Miss Mary Anglemeyer visited the College and secured information regarding the College library.

Miss Filomena Mercado, librarian of the College, was the recipient of a fellowship from Australia which enables her to attend a seminar course in library science and to travel in Australia for about three months. She left by plane on February 19, 1952.

Mrs. Conchita Alonte Orillo has been appointed instructor in the Department of Agricultural Chemistry. She was formerly working in the same department as a researcher under the Institute of Nutrition.

The biological science classes of the Philippine Union College, headed by their instructor, Mr. R. C. Imperio, visited the College on February 18, 1952. Dr. José R. Velasco of the Department of Agricultural Botany gave the visitors a lecture on botany and showed them the laboratories, experimental cultures, and garden plots of the department.

The Rural High School Junior-Senior dance was held on February 16, 1952, at the Rural High School Auditorium, under the guidance of Mr. Martin V. Jarmin, adviser of the junior class, and Mr. Crispin R. Las Marias, adviser of the senior class. The presidents of the respective classes are Rogelio Vega and Antonio Mabesa.

The College Speech and Dramatics Club presented "The Valiant," a one-act play, at the Chemistry Lecture Hall on the evening of February 22, 1952. The cast included Sofronio Blando, Rodolfo Ylarde, Gloria Vega, and Emmanuel Pili. John Taylor is the president and Mrs. M. I. Sevilla, the adviser of the club.

Mr. Jose M. Trinidad, '18, chief of the technical division of the Department of Agriculture and Natural Resources, recently left for the United States to make agricultural observations under a Smith-Mundt travel grant.

Mr. Francisco Galang, '14, and Mr. Olimpio R. Fontanilla, '33, accompanied by Mr. John Hepler and Father Rafael, visited the College on February 21, 1952. They conferred with members of the College faculty regarding the holding of an in-service training course for agricultural extension workers.

Dr. Valente Villegas, '13, head of the Department of Animal Husbandry of the College, gave a talk on agriculture to the senior students of the Tanauan Institute, Tanauan, Batangas, on February 24, 1952, in connection with the vocational guidance program of the institute.

Messrs. Agripino Constantino, '15, Daniel F. Francisco, '40, and Florante C. Salvador, '50, instructors in the Morong High School, Morong, Rizal, accompanied their classes on an educational trip to the College on March 1, 1952.

Mr. Juan Pancho, '51, has been appointed research assistant in the Department of Agricultural Botany of the College.

Mr. Teopisto L. Loredo, '38, is the agriculturist and assistant administrator of the U. P. Land Grant at Basilan City.

THE CENTRAL EXPERIMENT STATION

LIST OF AVAILABLE PUBLICATIONS

No. 2.—Bud Rot of Coconut ..... *By G. O. Ocfemia*

No. 8.—Horse Breeding in the Philippines ..... *By V. Villegas*

No. 11.—The New College Copra Drier ..... *By Moises M. Kalaw* (Revised)

No. 17.—College Trapnest ..... *By F. M. Fronda and P. S. Paje*

No. 18.—Surveying for Area with a Surveyor's Staff ..... *By Alexander Gordon*

No. 23.—Curing Pork and Making Sausage for Home Use ..... *By Mariano Mondoñedo*

No. 24.—Construction and Operation of Silos in the College of Agriculture ..... *By J. P. Esguerra*

No. 29.—Collegiate Education in Agriculture ..... *By Leopoldo B. Uichanco*

No. 30.—What Should Filipino Ornamental Gardens and Ornamental Plants Be? ..... *By N. B. Mendiola*

The price of the circulars listed above is thirty centavos (P0.30) each.

All orders for circulars with payment should be addressed to the Business Manager, THE PHILIPPINE AGRICULTURIST, College, Laguna, Philippines.

PHILIPPINE AGRICULTURE, Volume 1 { Cloth bound ..... P10.00; Postage 0.40

A MANUAL OF PLANT BREEDING FOR THE TROPICS P6.00

All orders for books with remittance should be addressed to:

THE DEAN AND DIRECTOR
COLLEGE OF AGRICULTURE AND
CENTRAL EXPERIMENT STATION
COLLEGE, LAGUNA, PHILIPPINES

The Philippine Agriculturist

(Formerly The Philippine Agriculturist and Forester)

Published by the COLLEGE OF AGRICULTURE
AND CENTRAL EXPERIMENT STATION
UNIVERSITY OF THE PHILIPPINES

Vol. I—2

Vol. III—9-10

Vol. V—2, 6, 7, 9, 10

Vol. VI—1, 2, 3, 4, 6, 7, 8, 9, 10

Vol. VII—complete

Vol. VIII—3, 4, 5, 6, 8-9, 10

Vol. IX—3, 4-5, 8-9

Vol. XI—3, 7, 8

Vol. XIII—1, 10

Vol. XIV—1, 2, 3, 4, 5, 6, 7, 9, 10

Vol. XV—complete

Vol. XVI—3, 8, 9, 10

Vol. XVII—6, 7, 8, 9, 10

Vol. XVIII—complete

Vol. XIX—complete

Vol. XX—complete

Vol. XXI—complete

Vol. XXII—complete

Vol. XXIII—1, 2, 3, 4, 6, 7, 8, 9, 10

Vol. XXIV—complete

Vol. XXV—complete

Vol. XXVI—complete

Vol. XXVII—complete

Vols. XXVIII, XXIX, and XXX—burned

Vols. XXXI, XXXII, XXXIII, and XXXIV—complete

Back copies of Vols. I to XXVII sell at 50 centavos and back copies of Vols. XXXI to XXXIV sell at P1.50.

Consolidated index (Vols. I to XX) 50 centavos excluding postage.

Send your order to the BUSINESS MANAGER, THE PHILIPPINE AGRICULTURIST, COLLEGE, LAGUNA, PHILIPPINES.